Compressed Air Magazine

JULY 1945

TOP-HATTED
G. I. DIGGER

A bit of doughboy comedy relieves the tension as fighting ends in Germany.

VOLUME 50 • NUMBER 7

NEW YORK • LONDON

COOL HEADS IN "HOT SPOTS" WON'T LET YOU DOWN

On jobs where the air is foul or hot, men can't be blamed too much for letting up now and then. If you want to keep their efficiency and morale high, feed them better air.

Employers have learned the value of putting Coppus Blowers and Ventilators on the job . . . in confined areas and near furnaces or hot processes. The men work faster, do better work, work longer without fatigue — and appreciate the more comfortable working conditions.

Give some thought now to the "hot spots" in your plant. There is a Coppus Blower for practically any requirement — Cable Manhole and Tank Ventilators, Boiler Manhole Blowers and Exhausters, Heat Killers, Shiphold Ventilators, etc. The Coppus "Blue Ribbon" is your assurance of design and construction planned for plenty of severe service. Check and mail the coupon for specific information. Address Coppus Engineering Corp., 207 Park Avenue, Worcester, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP., 207 PARK AVENUE, WORCESTER 2, MASS.
Please send me information on the Blowers that clear the air for action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausters, welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME.....

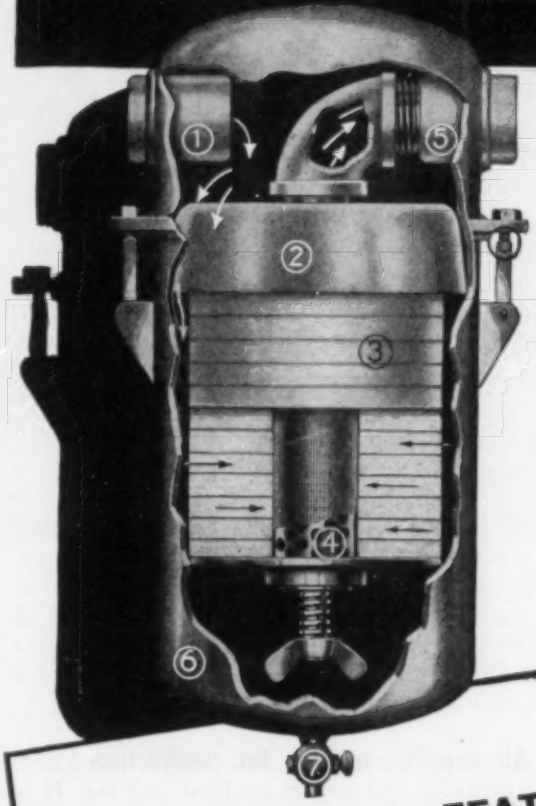
COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have).

HAZARD of Oil and Moisture in Automatic Controls NOW ELIMINATED



New Filter Delivers Dry Air Only

Amazing results are being reported by users of the Model AAPHS Pipe Line Filter as a final stage in the protection of delicate pneumatic control instruments.

Typical comment is that of a large producer of electric and steam power who says, "We tried several well-known methods of moisture and oil elimination without satisfactory results. Your Model AAPHS was finally installed in the air line and since then we have had no trouble whatever with oil or moisture in our automatic controls."

NEW 44-PAGE CATALOG: Describes entire line, including filters for building ventilation, pipe lines, engine, and compressor intakes. Your copy is ready.

DOLLINGER CORPORATION
(Formerly Staynew Filter Corp.)
7 CENTRE PARK, ROCHESTER 3, N. Y.

"Air Filter Headquarters"

STAYNEW PROTECTOMOTOR FILTERS

CONSTRUCTION FEATURES

(1) inlet; (2) baffle that distributes vapor-laden air to sides of container; (6) felt rings; (3) felt ring liner; (5) outlet; (7) drain cock; (8) perforated swing bolts for easy inspection (optional).

THICK FELT RINGS that remove every trace of oil or moisture.

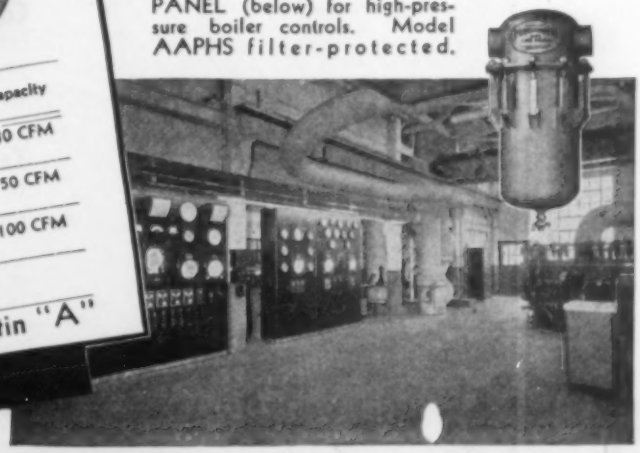
SPECIFICATIONS

Model	Standard Pipe Size	Capacity
AAPH-0S AAPHS-0S	¼"	5 CFM
AAPH-01 AAPHS-01	¼"	7 CFM
AAPH-0 AAPHS-0	½"	10 CFM
AAPH-1 AAPHS-1	¾"	20 CFM
AAPH-2 AAPHS-2	1"	30 CFM
AAPH-4 AAPHS-4	1½"	50 CFM
AAPH-5 AAPHS-5	2"	100 CFM

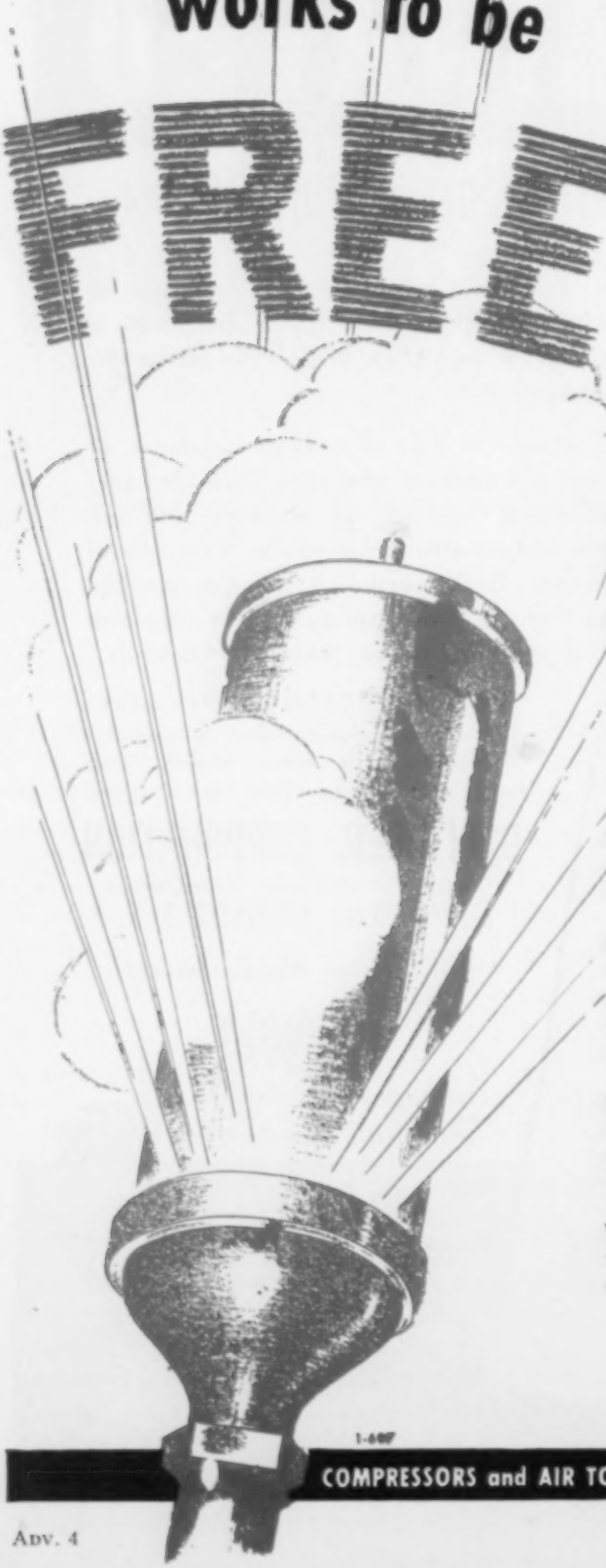
Letter S in code numbers indicates swing-bolt type which facilitates inspection.

Write for Bulletin "A"

PANEL (below) for high-pressure boiler controls. Model AAPHS filter-protected.



LIKE MAN, COMPRESSED AIR works to be FREE



Compressed Air has an inherent urge to be free . . . to escape from the confinement of a storage tank, or pipe, or the cylinder of a machine.

To attain freedom, *Compressed Air* will expand and push until all of its energy has been expended or released. This is *compressed-air power* at work. Engineers apply it to make man's work easier, better, and more productive.

Compressed Air pushes pistons or the blades of wheels to exert its power in air tools, such as drills, riveters, wrenches, hoists and rock drills. It operates air brakes, the switches and signals in railroad yards, and the controls of complicated processes . . . clamps the jaws of chucks in machine tools. It "fires" torpedoes from their tubes, operates their controls, and spins their gyroscopes.

Compressed Air supplies oxygen for combustion in oil, gas, and coal furnaces and boilers on land and sea. It is essential in blast furnaces and foundry cupolas.

Compressed Air creates powerful streams or blasts of air when it is suddenly released. These create waves of sound for whistles . . . hurl particles of sand for smoothing metal castings . . . spray paint . . . carry huge quantities of grain through tubes . . . scavenge and cool the barrels of naval guns.

Compressed Air expands as it tries to obtain freedom, inflating tires, displacing water ballast when a submarine surfaces, and raising sunken ships. It bubbles through liquids to pump by "air lift," and to agitate them.

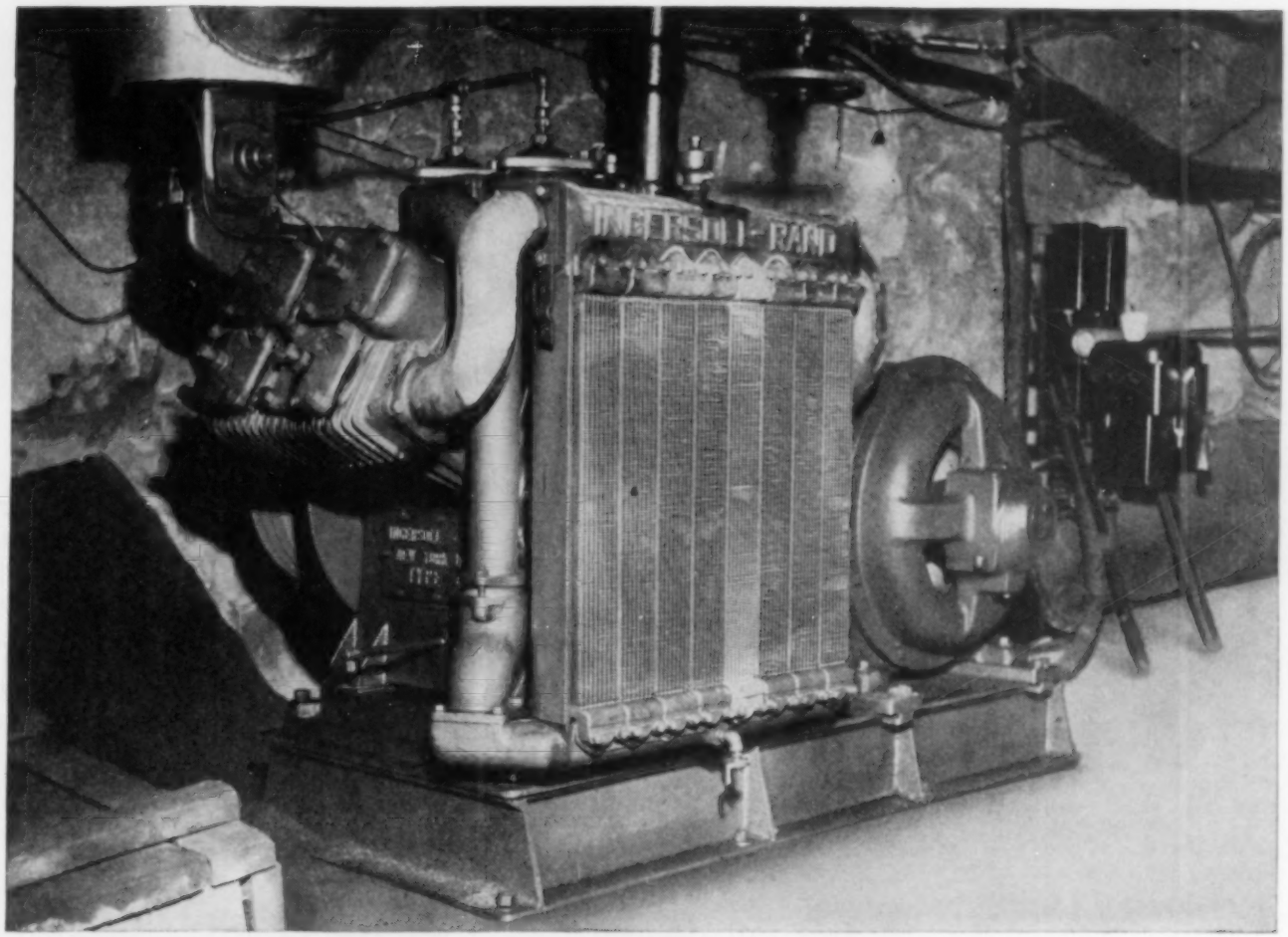
Yes, like man, Compressed Air works in countless ways to be free. Perhaps it can do more for you. Our applications engineers will be glad to help in any way possible.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

1-697

COMPRESSORS and AIR TOOLS built and applied by the men who know AIR POWER



"Air Power"... Underground

IN addition to countless above-ground uses, compressed air also works underground — powering drills, hoists, loaders and other mining equipment. Whatever the job for compressed air, the best assurance of efficient trouble-free compressor operation is effective lubrication—Texaco.

Texaco Alcaid, Algol or Ursa Oils in compressors assure wide-opening, tight-closing valves, free piston rings, open ports, clear lines, continuous air supply. They also assure maximum service life between overhauls, fewer repairs and replacements. Their use in compressors is worldwide.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

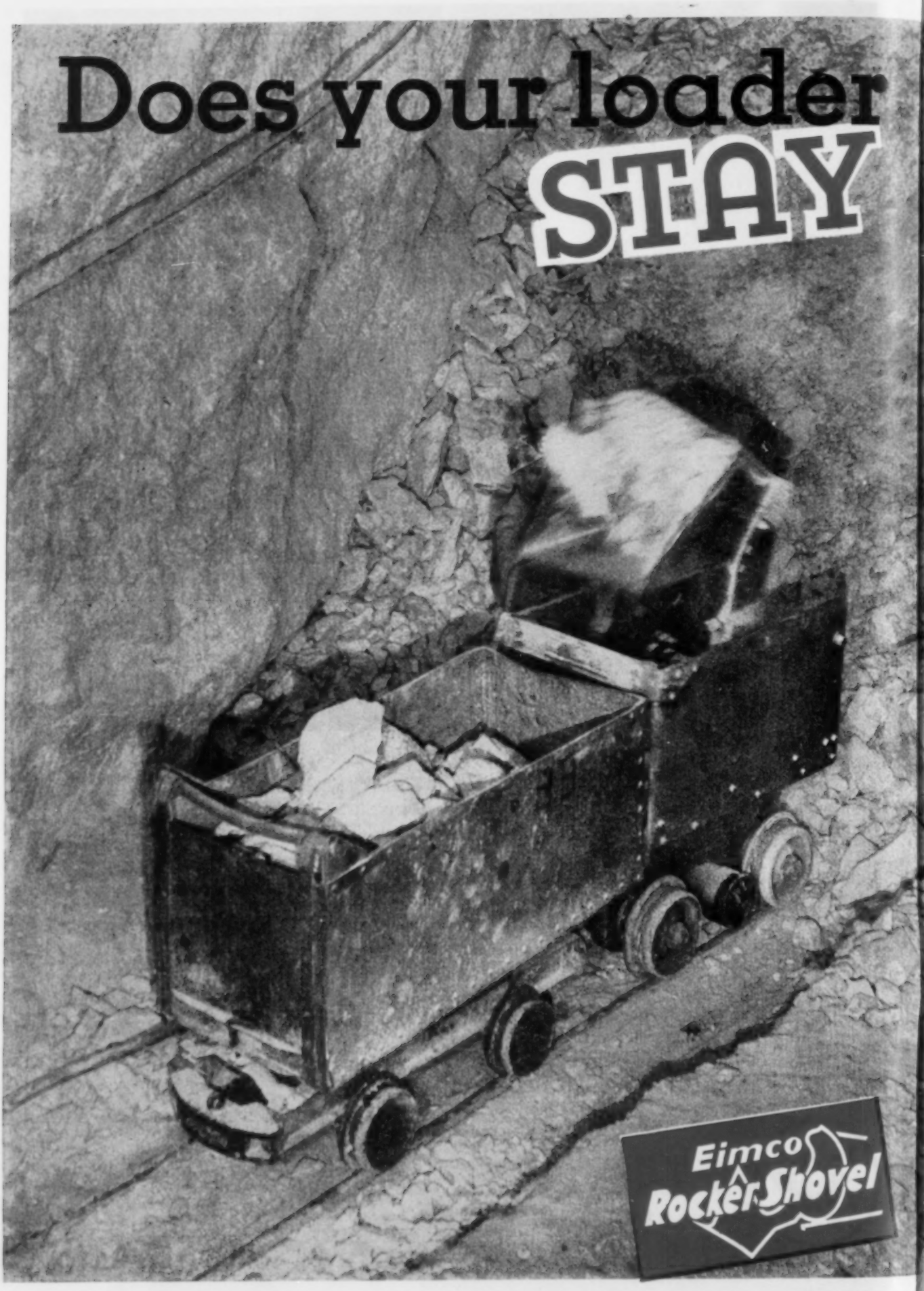
★More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

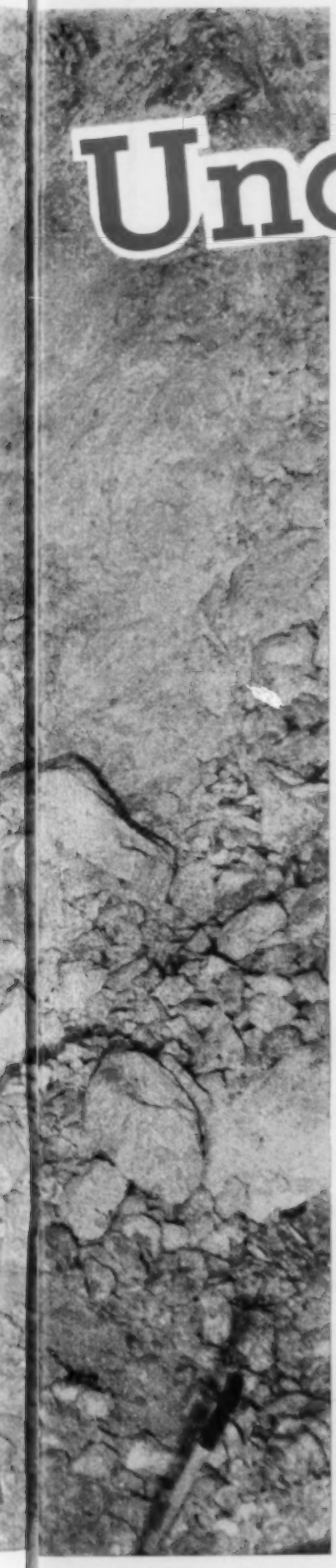
TEXACO

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS


Does your loader
STAY
Eimco
Rocker Shovel



Underground?

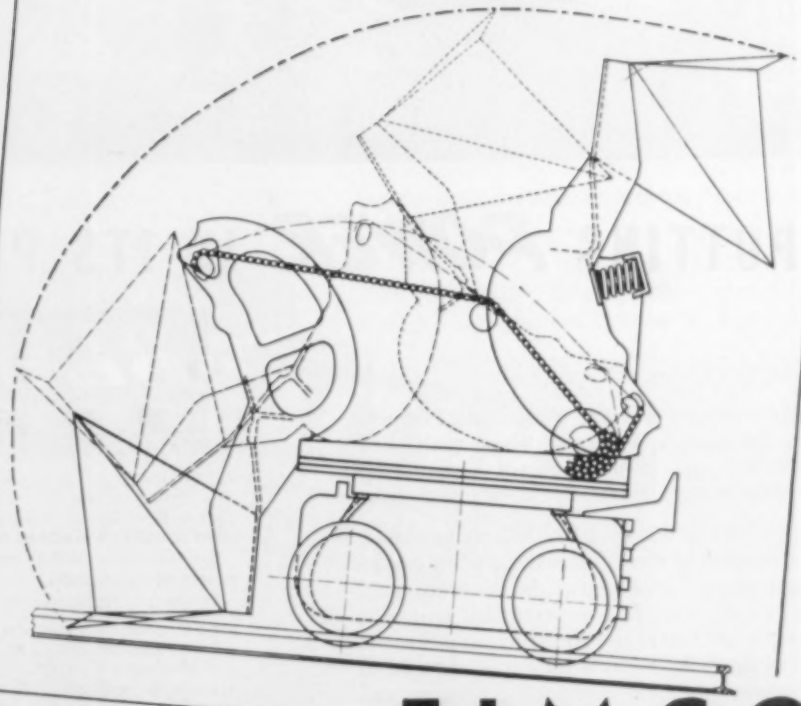
If it's a RockerShovel the answer is, "Yes!" Eimco RockerShovels are designed and manufactured by men who know intimately the tough conditions under which machinery must operate underground. Hundreds of letters, from users everywhere, bear testimony to statements like these . . . "After 4 years continuous service we brought our RockerShovel to the surface . . ." "This machine had been working two shifts daily for 7 years underground, with only minor repairs . . . " "We finally brought it (RockerShovel) to the surface for general check-up after 46 months of two shifts every day . . . "" Yes! RockerShovels stay underground, and here's another of the many reasons.

Location of chain reel with respect to pull point on rocker-arms at dumping position (covered by an Eimco patent) prevents dumping shock from being transmitted through gear train, motors or running parts.

Study the diagram

You'll see another of the many patented features which keep RockerShovels

Shoveling underground



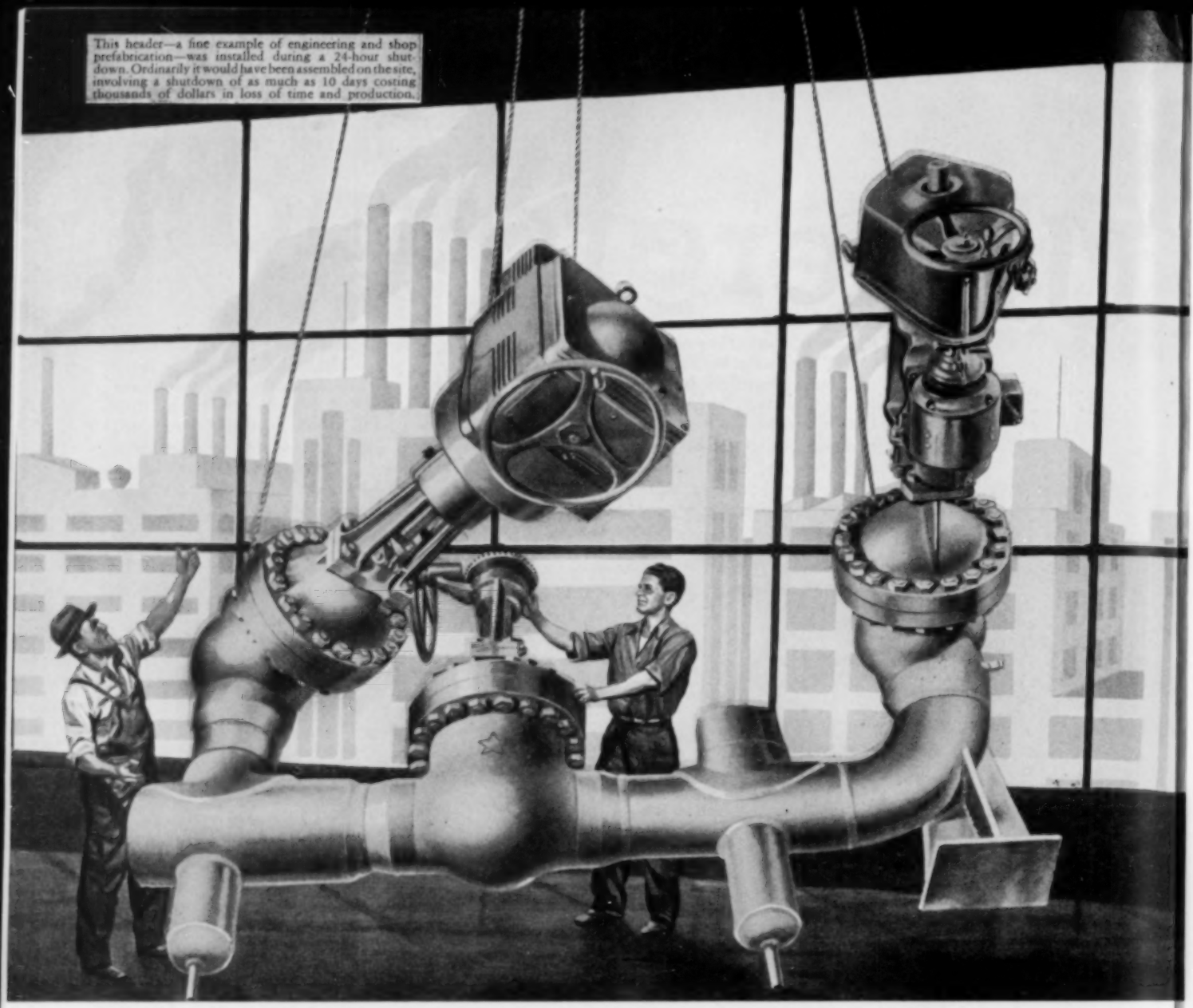
A94

Model 21 RockerShovel
International Talc Co.
Gouveneur, New York

EIMCO

THE EIMCO CORPORATION

Executive Offices and Factories: Salt Lake City 8, Utah
Branches: New York, Chicago, El Paso, Sacramento, St. Louis



This header—a fine example of engineering and shop prefabrication—was installed during a 24-hour shutdown. Ordinarily it would have been assembled on the site, involving a shutdown of as much as 10 days costing thousands of dollars in loss of time and production.

PUTTING *POWER* IN ITS PLACE . . .

Blaw-Knox Prefabricated Piping, Functional Hangers and Vibration Eliminators are in use where multiplied production for the war effort demands unremitting stability of power piping lines and speed of installation.

Power Piping is but one of many Blaw-Knox products. Blaw-Knox is intimately identified with quality equipment and engineering "know how" in the iron, steel and non-ferrous industries, in equipment for railroads, public utilities, the electronic and construction industries and industry in general. It has achieved leadership in engineering, designing and producing plants and equipment for the chemical and process industries.

As Blaw-Knox can serve you with prefabricated piping, so it can serve you—with products and engineering—in all the fields in which it is active. Perhaps we can help you with your present or future activities. We will be glad to discuss it with you.

BLAW-KNOX COMPANY

A PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

2023 FARMERS BANK BLDG.
PITTSBURGH, PA.

Six Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

LEWIS FOUNDRY & MACHINE DIVISION,
Rolls and Rolling Mill Machinery

POWER PIPING DIVISION,
Prefabricated Piping Systems

SPECIAL ORDNANCE DIVISION,
Bofors Anti-Aircraft Gun Mounts and Mechanisms

BLAW-KNOX DIVISION,
Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

CHEMICAL PLANTS DIVISION,
Chemical and Process Plants from laboratory to production

PITTSBURGH ROLLS DIVISION,
Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION,
Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION,
Heat and Corrosion-Resistant Alloy Castings

MARTINS FERRY DIVISION,
Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION,
Automatic Sprinklers and Deluge Systems

BUFLOVAK EQUIPMENT DIVISION,
Food Processing Equipment, Evaporators, Dryers, Distillation and Solvent Recovery Equipment, etc.

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · POWDER PLANTS · PIPING FOR NAVAL VESSELS
SYNTHETIC RUBBER PLANTS · GUN SLIDES · 14" PROJECTILES · LANDING BARGES
ROCKETS · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS

Twice MODERNIZED *with* EASTON SEMI-TRAILERS *at* COLUMBIA

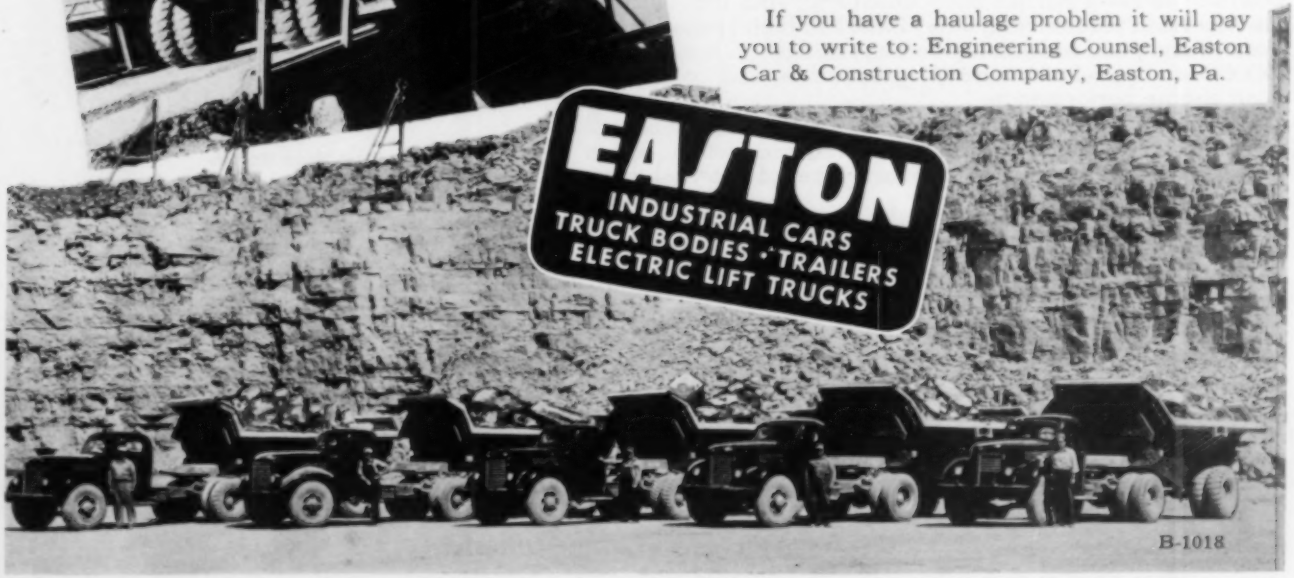
"Red" Heise manages the Krause No. 1 plant at Columbia, Illinois—a property of the Columbia Quarry Company of St. Louis. Here EASTON 10-ton semi-trailers modernized the haulage operations in 1938, replacing 5-yd. cars and locomotives.

By 1944 the production schedule called for larger tonnages at the crusher. EASTON 17-ton capacity semi-trailers of modern design were installed to speed the haulage cycle.

This fleet of five EASTON TR-13 units is now delivering 1,250,000 tons annually with top efficiency and low maintenance. The average round trip haul at Krause No. 1 is exactly one mile.

If you have a haulage problem it will pay you to write to: Engineering Counsel, Easton Car & Construction Company, Easton, Pa.

EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS



B-1018

TOOLED for production in the millions

and for *PRECISION* in the millionths

When aeronautical engineers first asked for rings with a surface flatness within .000006-in. tolerances, many manufacturers dismissed the idea as impossible.

But to American Hammered engineers, the word "impossible" is not a barrier but a challenge. And thousands of the American planes flying today have had their speed, climb, maneuvering and availability ceilings raised . . . because the .000003-in. side finish extends groove life, and so extends peak engine performance.

The benefits aren't confined to aircraft. New standards of flatness have been applied to *all* ring production, which improve the performance of every type of internal combustion engine.

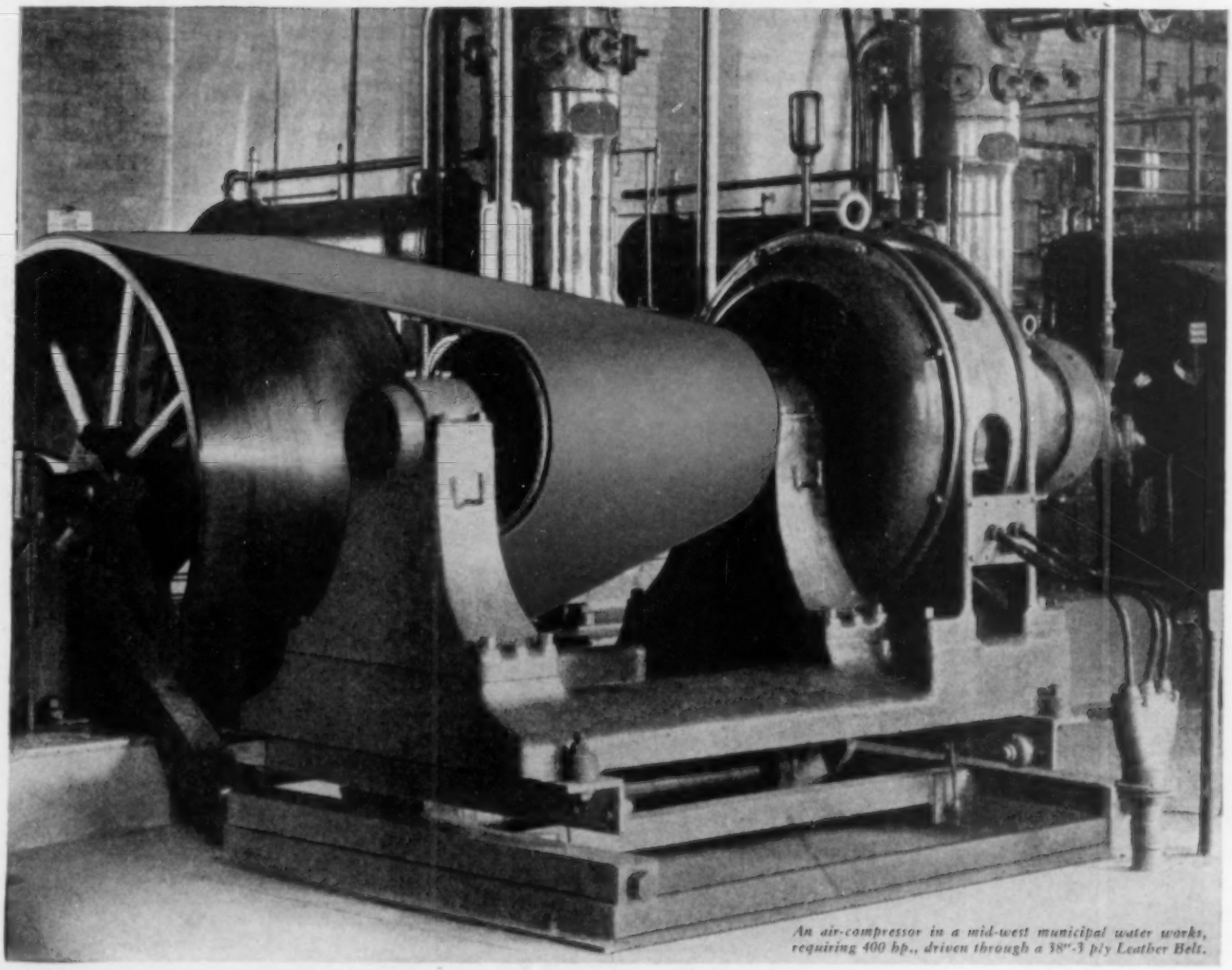
Producing over 100,000,000 wartime rings has left us better-than-ever equipped to give you improved Piston Rings in Every Size—of Every Type—for Every Purpose.

KOPPERS COMPANY, INC.
AMERICAN HAMMERED PISTON RING DIVISION
Baltimore 3, Maryland

KOPPERS
THE INDUSTRY THAT SERVES ALL INDUSTRY

FOR TOMORROW—*Count on those who are doing the tough job today*

ONLY *Leather Belting* CAN DO THIS JOB PROPERLY



An air-compressor in a mid-west municipal water works, requiring 400 hp., driven through a 38"-5 ply Leather Belt.

"INDUSTRY LEARNS BEST FROM EXPERIENCE"

If you look in on many of the really "tough" jobs of Industry, you will find that Leather Belting rates high as a means of power transmission.

There are many good reasons why, but engineers whose job it is to see that the required power can be delivered to operating equipment, speak highly of its pulley-gripping characteristic that actually increases with increased load. They can count on Leather Belting to meet all load conditions.

This fact in itself reflects a real dependability which can be "standard" in War or Peace, in plants that rely on Leather Belting.

LEATHER BELTING IS EASY TO SELECT, INSTALL AND MAINTAIN, AND CARRIES THE LOAD!

AMERICAN LEATHER BELTING ASSOCIATION • 41 Park Row, NEW YORK 7, N. Y.

THE BLACKSMITH PICKS A *Winner*

You've heard about dope that's "straight from the feed box."

Here's how to get it on drill steel: go to the blacksmith who's working with BETHLEHEM SUPERIOR.

Chances are, he can tell you some pretty solid facts.

He'll tell you . . .

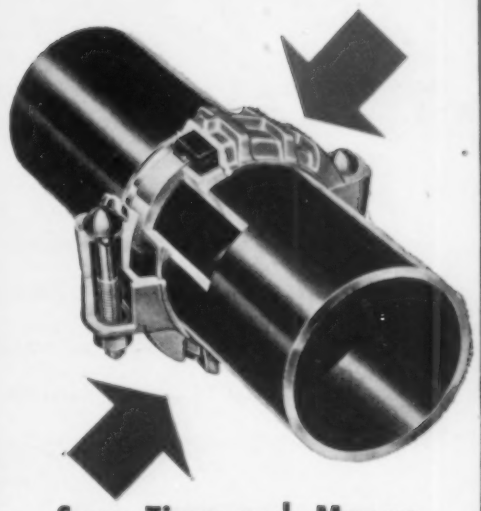
- ★ That the hole of this tough hollow drill steel is smooth and well-centered.
- ★ That BETHLEHEM SUPERIOR makes up readily, is always true to size.
- ★ That it heat-treats easily because it has a wide quenching range which gives a better hardness.
- ★ And he'll probably mention that it's equally suitable for forged-on bits and threaded rods used with detachable bits.

It all adds up to a winning combination—and he knows it.

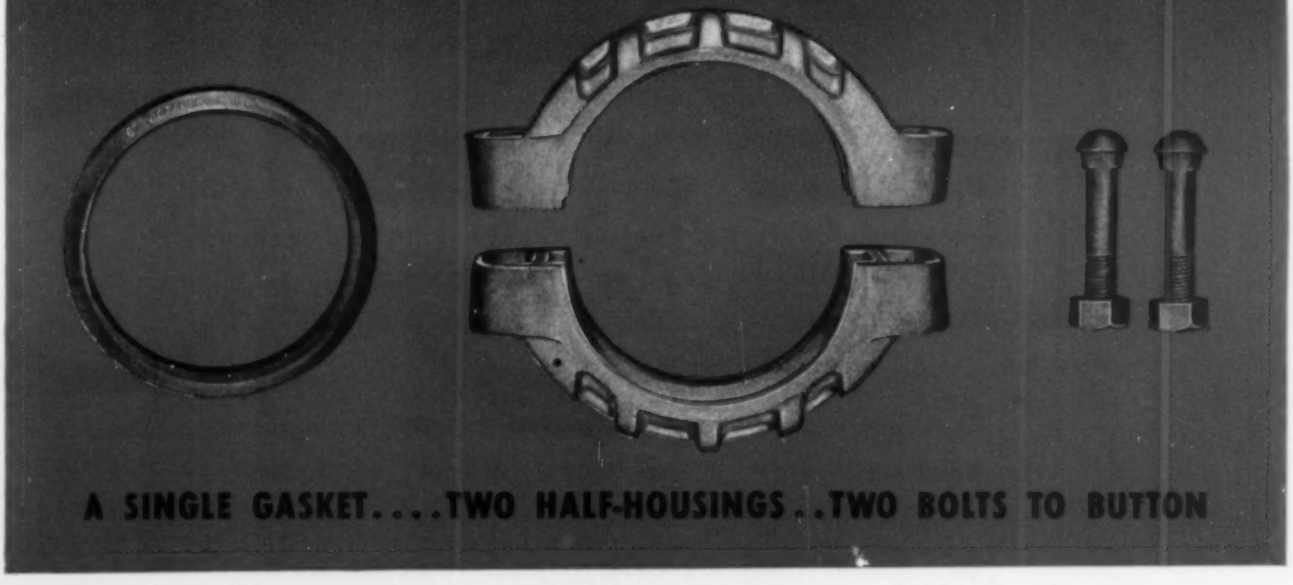
BETHLEHEM SUPERIOR HOLLOW DRILL STEEL

BETHLEHEM STEEL

INSTALLATION COSTS HIGH?....



Save Time and Money with Victaulic Couplings



A SINGLE GASKET....TWO HALF-HOUSINGS..TWO BOLTS TO BUTTON

WAR BONDS
A PIPE LINE THAT HELD TO BUILD

Simple? Yes. *And cheaper to install.* And *more efficient to operate.* Here's why...

1. The Victaulic Coupling is so simple, it can be fitted rapidly even by inexperienced men—a *saving in skilled man-power.*
2. Victaulic Couplings center themselves *automatically* on the pipe—a *saving in valuable man-hours.*
3. Victaulic Couplings have *built-in flexibility,* which eliminates time-consuming alignment, and enables the pipeline to follow the contours of the ground with a minimum of fittings—a *saving in material.*

For greater pipeline effieiency and economy, use Victaulic Couplings... and the companion line Victaulic Full-Flow Pipe Fittings... THE VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. Other Victaulic offices—Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Co. of Canada, Ltd., 200 Bay St., Toronto.

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

Copyright 1945 by Victaulic Co. of America

OIL MINING MARINE MUNICIPAL INDUSTRIAL

. . THE *Right* BOILER-FEED PUMPS

There is a modern and efficient Ingersoll-Rand boiler-feed pump for any boiler plant from the smallest to the largest.

For small and moderate sized industrial plants, the two-stage Motorpump is ideal. The motor driver is built on the same shaft as the pump making a unit of extreme compactness. Built-in turbine-driven units of the same design are also available. They operate at discharge pressures up to 250 psi.

Class MRV two-stage Motorpump operates at pressures up to 200 psi, four-stage units up to 250 psi.

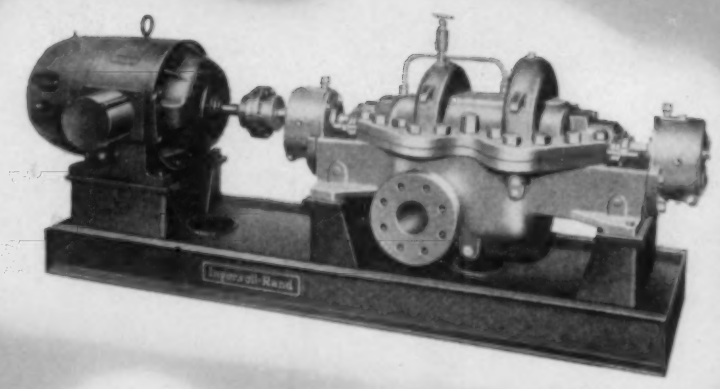
For somewhat larger plants, two-stage Class GT pumps are available. They are efficient units which have proved themselves in hundreds of installations. They are built for pressures up to 450 psi.

For large industrial installations and moderate size utility installations, there is a wide selection of 4, 6 and 8-stage volute type pumps in the CNT and RT lines. These units have been carefully designed and built to secure the utmost in operating economy and dependability. They are suitable for pressures up to 1200 psi.

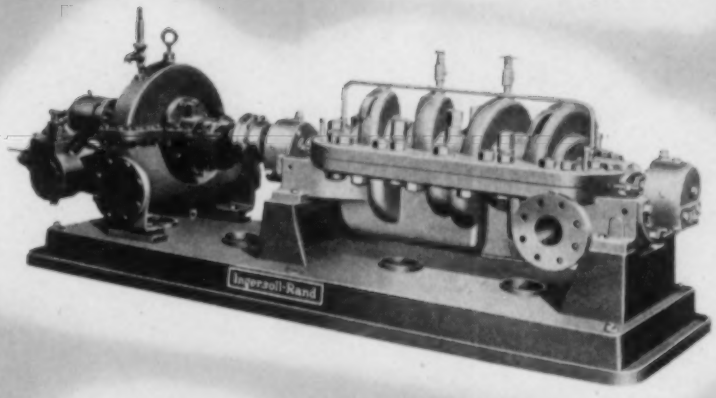
Then there are those masterpieces of super-precision, the I-R barrel type pumps for high-pressure boilers. Designed and finished as carefully as a fine watch, they are serving at pressures as high as 2900 psi.

In addition, there are other pumps; vertical units and diffusor-type units; pumps for special conditions that only Ingersoll-Rand can meet. Let our application engineer tell you more about the pump that will fit your boiler plant. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

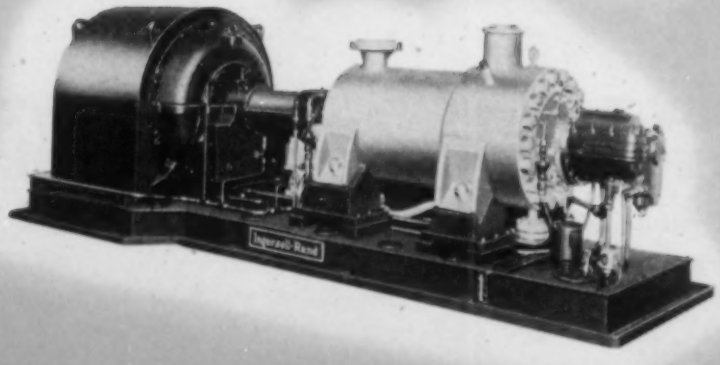
FOR POWER PLANTS OF ANY SIZE



Class GT two-stage pump for pressures up to 450 psi.



Class CNT pump. Available in 4, 6 or 8 stages for pressures up to 800 psi. Class RT units of similar basic design serve at pressures up to 1200 psi.



Class CHT pump. Units of this class are serving at pressures up to 2900 psi.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

CAMERON PUMP DIVISION

10-633

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES

IF YOU CAN'T GO THROUGH THE PLANT BE SURE YOU GO THROUGH THIS BOOK

● The best way to know a steel forging is to see it made. But rather than wait until you have the opportunity to come to Irvine, National Forge brings the plant to your desk in this new "how we do it" booklet.

The processes pictured in this book plus their factual descriptions, make it a timely work of helpful value to every designer or buyer of steel forgings. Your copy will be mailed, without charge of course, if you simply ask for it now.

NATIONAL FORGE & ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNA.

"WE MAKE OUR OWN STEEL"

"Tomorrow is *another* day"

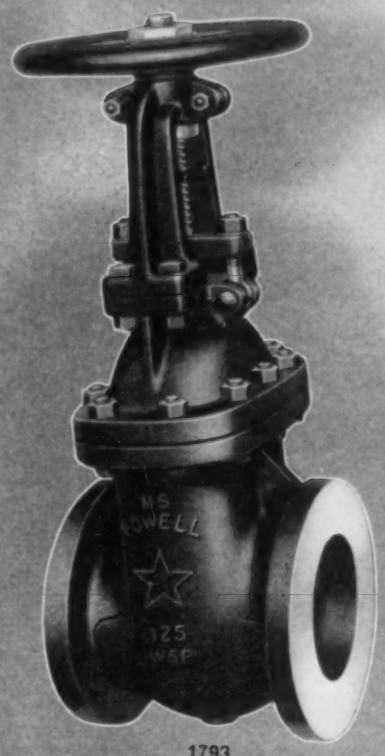
Because, for almost a century, Powell Engineering has been anticipating the flow control requirements of products and processes still in the laboratory stage, Powell was ready to meet—and has met—every new demand imposed by war. Today we can justifiably say "there's a Powell Valve for every *known* requirement of industry."

But "tomorrow is another day" and it will bring new problems in flow control. Powell, as always, will be ready to solve them.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio



1793

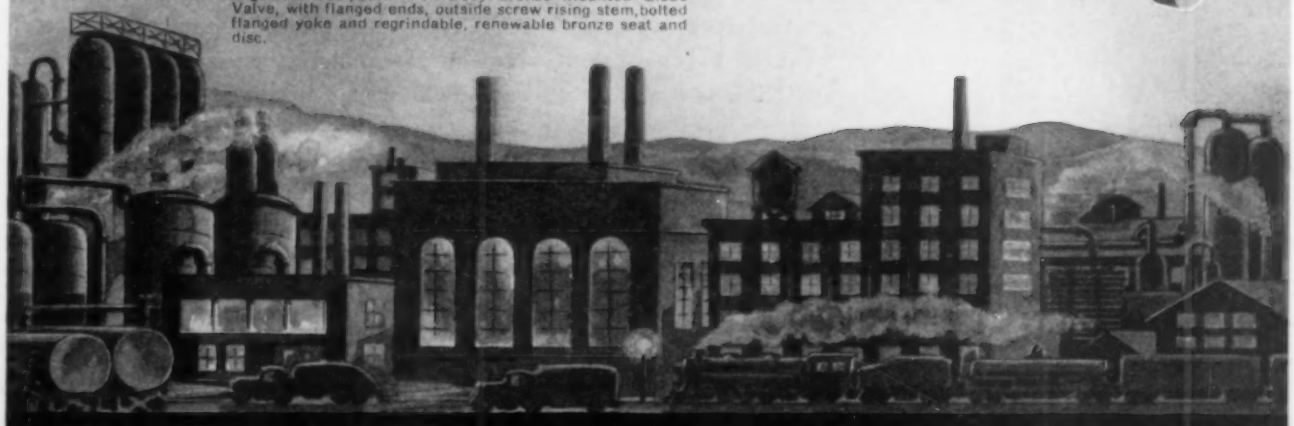
Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, bronze seats, and taper wedge solid disc. Available with taper wedge double disc—Fig. 1444.

559

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve, with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc.

256

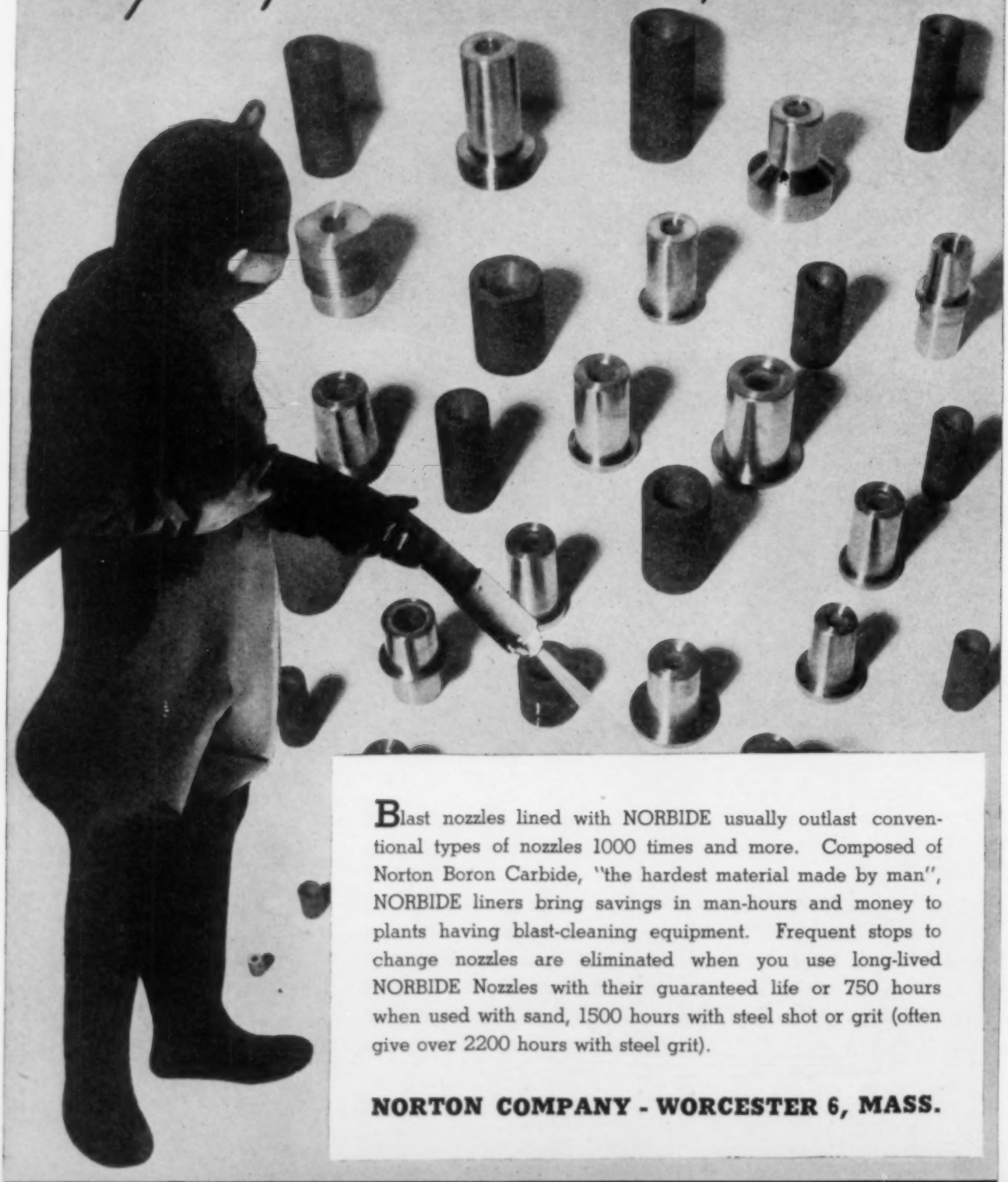
Fig. 256—250-pound Iron Body Bronze Mounted Globe Valve, with flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.



POWELL VALVES

NORBIDE* NOZZLES

Give up to 1000 Times Longer Service



Blast nozzles lined with NORBIDE usually outlast conventional types of nozzles 1000 times and more. Composed of Norton Boron Carbide, "the hardest material made by man", NORBIDE liners bring savings in man-hours and money to plants having blast-cleaning equipment. Frequent stops to change nozzles are eliminated when you use long-lived NORBIDE Nozzles with their guaranteed life or 750 hours when used with sand, 1500 hours with steel shot or grit (often give over 2200 hours with steel grit).

NORTON COMPANY - WORCESTER 6, MASS.

***Hardest Material Made by Man**

ON THE COVER

EVEN the grim business of war cannot suppress the innate sense of humor of American youths. Our cover picture, which is from an official Signal Corps photograph, shows T/5 Donald Pierce of Hartford, Conn., wearing a silk top hat while he digs a ditch with an air-operated pavement breaker at Prum, Germany, following its occupation by troops of the Third U. S. Army. With him, but clad entirely in G. I. clothing, is Pvt. Gerald J. Gignace of Detroit, Mich. He is operating a pneumatic clay digger.

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IN THIS ISSUE

BECAUSE we can buy chromium from abroad for less than we can mine it from our relatively low-grade ore deposits, we normally import our supply. Under wartime conditions, however, chromium becomes a strategic metal and is mined in both the United States and Canada. The article starting on the following page describes recent operations at two Canadian chromite properties.

•

ALTHOUGH air-operated tools have been used occasionally by the fire departments of some of our larger cities, it remained for Edward Lamb, a veteran San Francisco fireman, to devise methods and equipment for making compressed air an important agency in the business of fire fighting. Our second article tells of his efforts.

•

IF YOU have ever tried to see a stage production or a sports event from a seat located behind a post, you will cheer the idea of a covered stadium with unimpaired vision. As described in a 3-page article, Baltimore citizens are planning a huge structure of this type and propose to hold up its roof of thin aluminum sheets solely with compressed air.

•

THE animals, in *A Modern Noah's Ark* (page 185) don't march in two by two, but they're all there, even to the elephant and the kangaroo. R. G. Skerrett has given a colorful description of Louis Paul Jonas's miniature sculptures of mammals that are so faithful in detail as to be in wide demand for exhibition and study purposes.

Compressed Air Magazine

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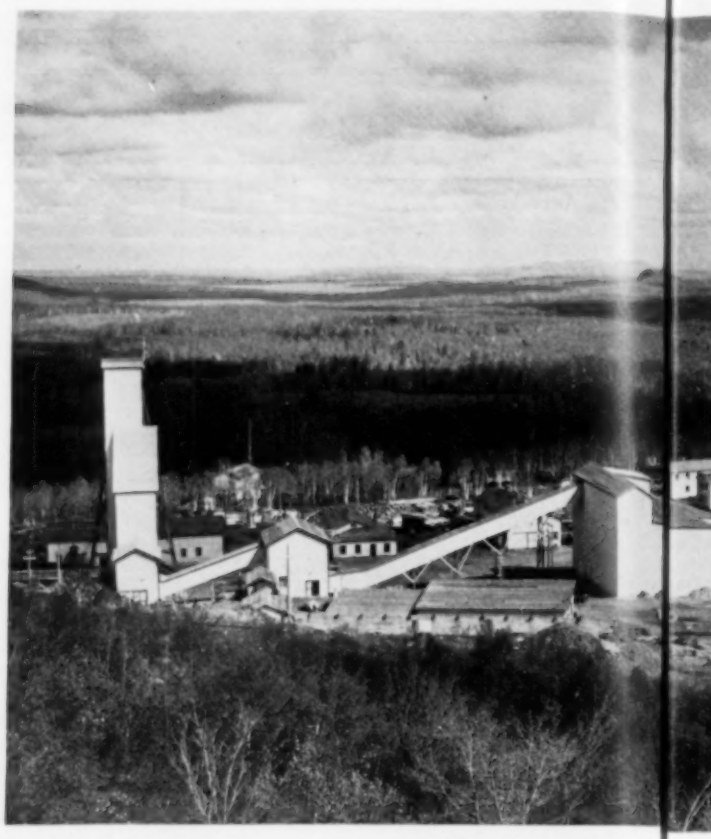
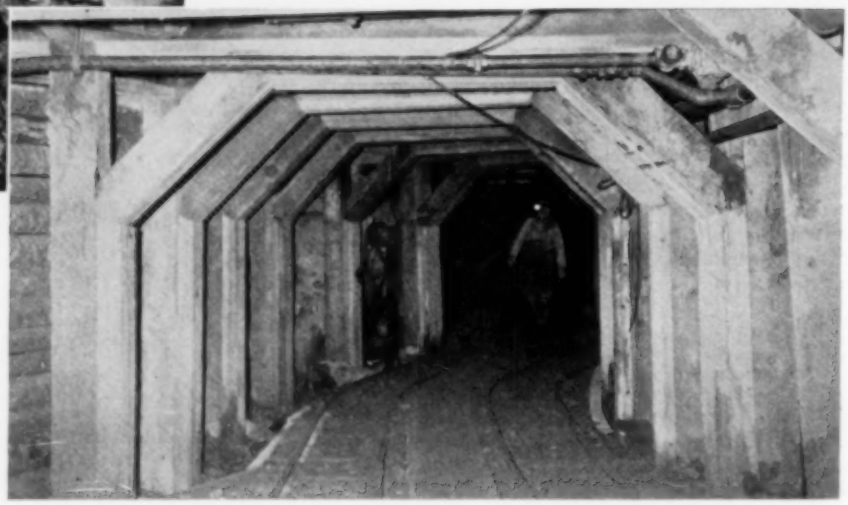
Canadian Chrome

W. M. Goodwin





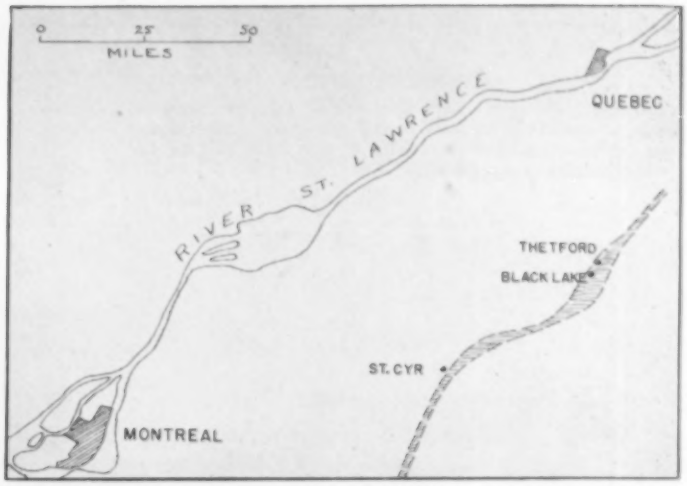
WHEN U-boat warfare had reduced Allied merchant shipping to a dangerously low tonnage in 1941-42, and no sure relief was in sight, every possible effort was made in the United States and Canada to develop local sources of chromite, one of the numerous ores and metals that are usually brought from overseas. Normally, the world's supply of this ore is drawn largely from high-grade deposits in Rhodesia, Turkey, India, and Russia. In the crisis, however, steps were taken to obtain the vitally important mineral from deposits of lower grade in North America. Thus, for the second time in a generation, the chrome resources of the eastern townships of Quebec were called upon to meet a war emergency.

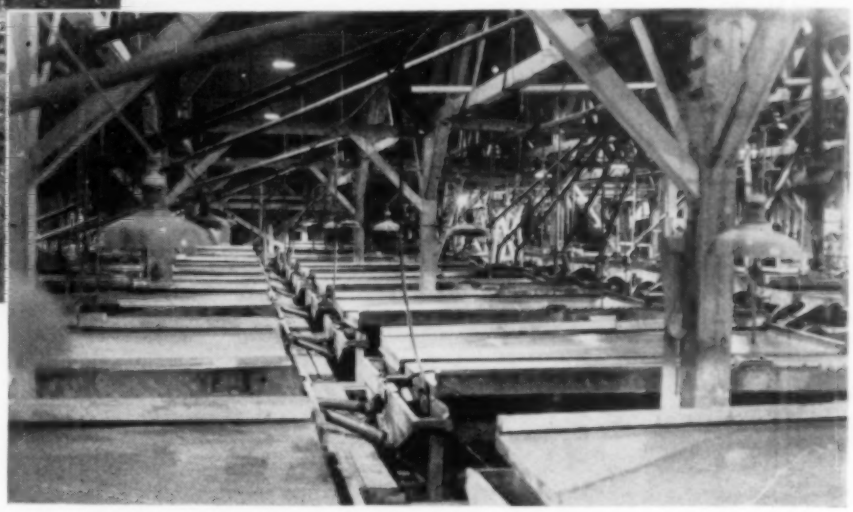
Chromium is essentially a modern metal. Its use began in the chemical industry about a century ago. For the succeeding 50 years the modest annual tonnage of chrome ore was obtained mainly from deposits in Maryland and Pennsylvania. The material was of comparatively low grade and was gradually displaced between 1860 and 1900 by ore from Turkey and Russia. More recently, large bodies of high-grade chromite discovered in Rhodesia have more than met the growing demand and have supplied about half the world's market, which had grown in the prewar years to the substantial total of close on a million tons annually.

About half of the ore was used in the metallurgical industry to make such products as stainless steel, high-tensile and high-speed steels, and electrical heating elements, in addition to armor plate and gun barrels. The other half was consumed in refractories, for plating, and in the chemical industry. War requirements have, of course, increased certain of these applications enormously; and, in general, the relative importance of chromium in munitions of war has grown markedly.

Though chromite was discovered in the eastern townships of Quebec in 1846 and small shipments were made during the next 50 years, it was not until 1894 that deposits of fairly substantial size were found and regular production was commenced. These ore bodies lie in the same rock formation that contains the world-famous asbestos deposits. In fact, specks of the mineral are disseminated throughout the asbestos pits, and small pockets are not uncommon. Bodies of

Photo by V. H. Minns





OPERATIONS AT CHROMERAINE

The cross-hatched strip on the map shows the course of a belt of serpentine and related rocks in Quebec that are of primary importance because they yield asbestos at Thetford. During two world wars they have also been worked for chromite. The Chromeraine Mine is at Black Lake and the Sterrett Mine is near St. Cyr. The photographs are of the Chromeraine property. The general view (center) was taken in October, 1943, and shows mine surface buildings on the left and the mill on the right. At the extreme left, miners are seen starting a new shaft that was sunk 375 feet as a part of the wartime production program. Typical heavy timbering used in the loose ground is illustrated in the picture of the main haulageway at the lower left. The view above shows concentrating tables in the mill where the ore was treated.

economic size, however, have been located only at some distance from the asbestos.

The Quebec deposits were of comparatively high grade, and for fifteen years the province obtained a sizable share of the available market. But by 1910 shipments from overseas, which had already compelled the operators in the United States to suspend work, also stopped chrome mining in Quebec. Resumption of operations in the province, as well as in the United States, came about as a direct result of the 1917-18 U-boat campaign. Work was started where it had left off ten years before on pockets of high-grade ore which could be obtained in lump form from the quarries. It was soon appreciated, however, that the much larger masses of chromite disseminated throughout the rock surrounding these pockets could provide a much larger tonnage of concentrate by a simple milling process. In consequence, several mills were erected, and in 1918 Quebec produced a total of 21,000 tons, or about 7 percent of the world's output—a comparatively small but relatively important quantity on account of the shortness of the supply in the United States.

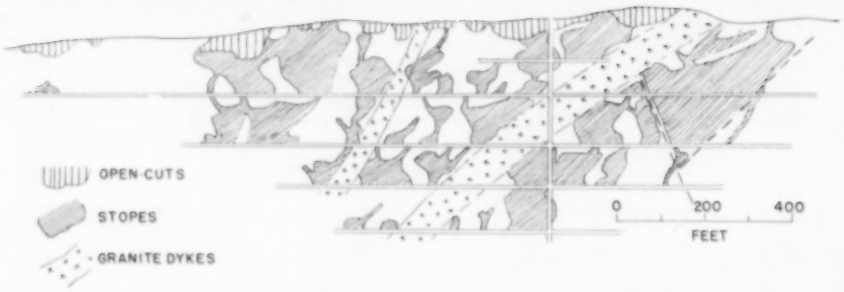
When importations from Rhodesia again began to arrive in 1919, all chromite mining on this continent stopped, and was resumed only under the pressure of necessity in 1941-42. During the succeeding year a sufficient quantity was obtained from domestic sources, but in 1944 shipments from Rhodesia once more threatened the industry. A few operators (including one in Canada) have been able to continue activities by virtue of the high chrome-ore prices that still prevail, but with the prospective lowering of ocean freight rates it is likely that production in the United States and the Dominion will again cease. Twice our deposits have been proved adequate by supplying the needs of the trade, but only at times when the price was high enough to yield a profit.

The chrome-bearing formation of Quebec is a belt of serpentine, peridotite, and related rocks that extends in a northeast-southwest direction south of the St. Lawrence River for a length of about 100 miles. At Black Lake, near the well-known asbestos mining center of Thetford, is the Chromeraine Mine, and near St. Cyr 40 miles to the southwest are the workings of Chromite Limited—the two Canadian mines that have responded to the latest call for the strategic mineral. A limited amount of customs ore, derived from open cuts in the neighborhood, has been treated at both properties.

During World War I, the larger percentage of Quebec's production of chromite came from a series of quarries and an underground mine at Black Lake. Some of the ore was shipped as hand-sorted lump, but most of it was treated in two mills to give a gravity concentrate. Part of the property was owned by United States interests, the Mutual

STERRETT MINE

The sketch shows a longitudinal section through the workings where the continuity of the ore body is interrupted by intrusions of granite. The photographs picture the mine headframe and the mill.



Chemical Company; and during the period between the global wars the remainder was acquired by the Vanadium Corporation of America.

When the Canadian Government, early in 1942, faced the possibility of having its overseas chromite supplies cut off at any time, it decided, on the advice of the Metals Controller, to take over and develop the deposits at Black Lake. While these were by no means the highest in grade, they were the largest known in Canada and gave promise of yielding ample concentrates to meet the country's needs for several years.

An agreement was made with the New York owners, and a firm of mining engineers, Futterer & Reid, was retained to determine the size and grade of the ore bodies. When these had been proven satisfactory, the concern was commissioned to design and build a mill and to work the deposits. These operations were under the supervision of Wartime Metals Corporation, a Crown company set up by the Dominion Government to produce "strategic" minerals from properties that were not expected to yield a profit under private ownership.

During the earlier mining activities, the workings had reached a depth in one part of the long ore zone of 300 feet. While a 400-ton mill was being erected a new shaft was sunk and a level established at 375 feet, and from the area above that level the operators expected to draw at least a two years' supply of ore. Development of the Chromeraine Mine was started in July, 1942, and in May, 1943, chromite production was begun. As it was extremely difficult at that time to obtain delivery of machinery from factories, the equipment of a worked-out mine in northwestern Ontario was purchased from Howey Gold Mines and brought to the site. It included all the necessary mining machinery, and most of the crushing and milling equipment, along with a goodly supply of spare parts. With the machinery came some of the men who had run it at the Howey Mine, thus speeding reërection and helping to insure smooth operation.

The ore at Chromeraine lies in a zone with a known length of more than 2000 feet. Within this area are numerous bands and irregular segregations of massive chromite from which came the lump ore mined by the former operators. The bulk of the available chromite is disseminated throughout the peridotite rock in grains, large and small. The material that can be considered ore pinches and swells throughout the zone, both longitudinally and vertically. The width reaches a maximum of 60 feet, with an average ranging between 20 and 30 feet. The dip varies, but is always steep.

Because the rock is shattered and contains many slips, it is well suited to the caving method of mining. However, it necessitated timbering all the drifts Draw points were put out from a drift in the footwall to tap the ore at 30-foot intervals, and each of these, for a distance of 15 feet from the ore body, was lined with concrete that was heavily reinforced with rails. The first block to be caved had a length of 250 feet near the surface and was withdrawn at four places.

To induce caving, the ore was undercut at drift level and a slot was started from raises along the footwall. As soon as the material began to move, no further assistance was needed, it continued to come down slowly and continuously, moving faster in the center than on the footwall and hanging wall, as had been expected. At the draw points, mechanical loaders dumped the ore into 1½-ton cars which discharged directly into skips. Oversize pieces were block-holed and blasted. There was a good deal of wear on the concrete lining of the draw points, with the result that it had to be renewed periodically.

Included in the descending V of ore, near the top, was a certain proportion of rock from both the foot and hanging walls. Consequently, the grade of the ore, which was 8.5 percent Cr_2O_3 at the start, fell to 6 percent at the end of operations. When mining ceased in August, 1944, preparations were underway to work from new draw points which would have restored the grade to 8.5 percent or better. The Chromeraine ore fortunately contains only a small percentage of magnetite. Therefore simple concentration on Wilfley tables, after crushing, grinding, and classifying,

gave a concentrate of 48 percent Cr_2O_3 and a recovery of 70 percent. The chrome:iron ratio was low, 2.4:1, but this was caused by the high iron content of the chromite itself rather than by admixture with any iron mineral that could be separated.

The Sterrett Mine of Chromite Limited, like the Chromeraine, is composed of a long banded zone that swells and pinches and is close to the vertical. But, unlike the latter, it is frequently interrupted by tongues of intrusive granite and numerous faults. The zone is known to contain an appreciable amount of chromite for a length of at least 3000 feet. It has a maximum width of 20 feet, averaging about 6 feet, and has been opened to a depth of 500 feet on five levels, the upper ones of which extend for a distance of 1800 feet. The wall rock varies a good deal, serpentine being the commonest and merging frequently into peridotite or dunite. Where granite dikes cut the ore, the basic rock is usually altered along the contact to a distinctly talcose material.

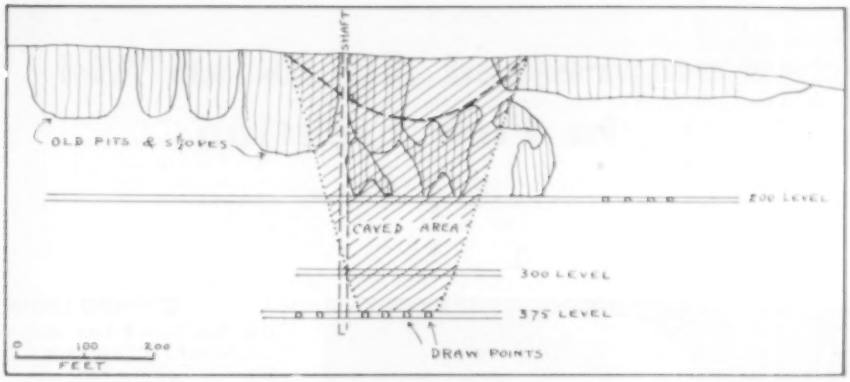
In contrast to the Chromeraine, the ore of the Sterrett Mine is inclined to be massive, averaging about 35 percent Cr_2O_3. Only a minor proportion of the recoverable chromite is disseminated throughout the wall rock. It was this more or less massive ore, hand-sorted from the open pits, that provided the bulk of the material shipped from this property 25 years ago. Today it pays better to raise the grade by milling.

The chromite is mined by shrinkage stoping, but in places it is too narrow to stope and is left as pillars. As the wall rocks are blocky, badly faulted, and fissured, dilution is severe. As a consequence, the ore averages only around 18 percent Cr_2O_3 as it is drawn from the chutes. The mill has a capacity of 150 tons a day, and milling is essentially the same as at Chromeraine; namely, crushing, grinding, classifying, tabling, and drying. On account of dilution with wall rock that carries little if any chromite, hand-picking is resorted to ahead of the crusher. Grinding is done in a rod mill, to which the middlings from the tables are returned.

As the bulk of the ore exists as vein matter with a moderate admixture of rock, fine grinding is not required and only a minimum proportion is slimed. Thus the concentrate is mainly sand, from coarse to fine, and good recovery is effected. A Fahrenwald hydraulic classifier gives three sand products and slime for tabling. All tailing from the coarse-sand table goes back to the rod mill for regrinding.

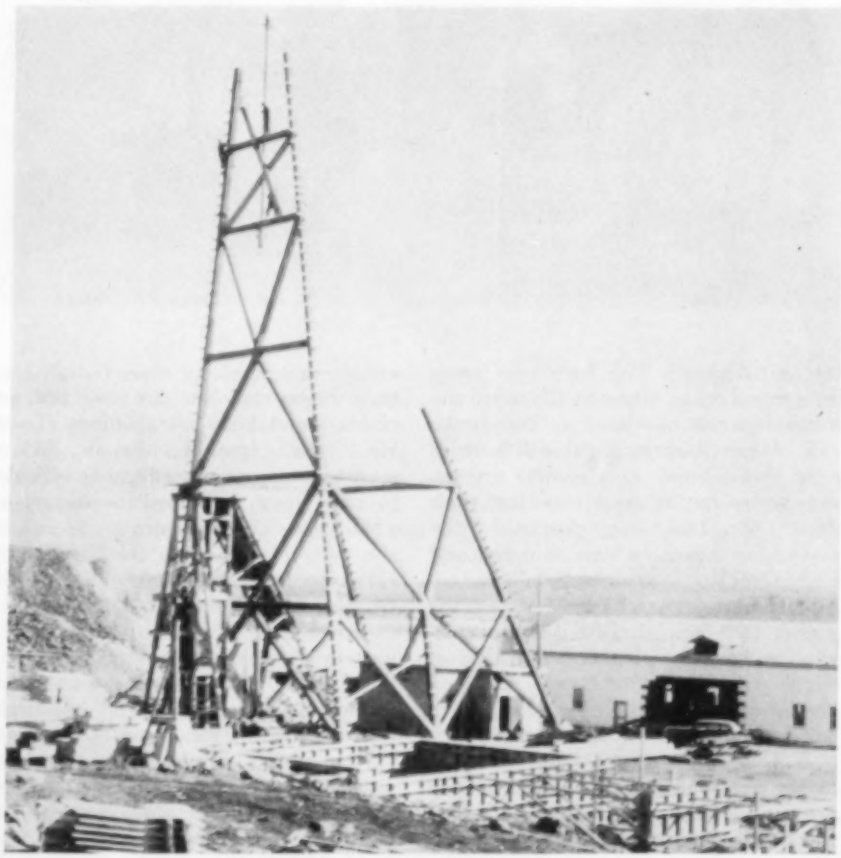
The concentrate is elevated by a drag conveyor to a vacuum pan for drying, the conveyor acting as a fairly efficient dewatering device. The vacuum pan is a tilting box that is filled by hand so that the fines will not segregate against the filter cloth on the bottom. A wet vacuum pump reduces the moisture content of the concentrate to 5 percent, which is satisfactory for summer shipments, but during the winter it is lowered to 2 percent (which does not freeze) by drying—letting the concentrate drop through an enclosed steam coil.

The concentrate, with an average of better than 48 percent Cr_2O_3 and a chrome:iron ratio of 2.75:1, has so far found a ready sale in the United States. The owners realize, however, that they cannot meet the normal competition of lump ores from overseas. Chromite Limited is a private company. To insure prompt output when the emergency arose in 1942 the Canadian Government offered it a loan. This was repaid some time ago. The mine has made a good record as a wartime producer of a strategic mineral.



CHROMERAINE MINING SYSTEM

A longitudinal section through the mine illustrating the caving system that produced ore at very low cost under safe working conditions. Circles on the 200- and 375-foot levels indicate the locations of new stoping operations that were being started when the mine was closed. At the draw points, mechanical loaders dumped the ore into 1½-ton cars which discharged directly into skips.



ERECTING NEW HEADFRAME

Because of the scarcity of steel, the headframe to serve the new shaft at the Chromeraine Mine was built of timber.

Compressed Air as an Aid in Fire Fighting

C. H. Vivian

EDWARD LAMB

who has shown how various types of compressed-air equipment can be applied to fighting fire. Mr. Lamb is a former army officer and also served on the San Francisco Fire Department for 30 years. He is a fire marshal of the U. S. Army and of Stanford University, as well as acting sergeant-at-arms of the International Association of Fire Chiefs.

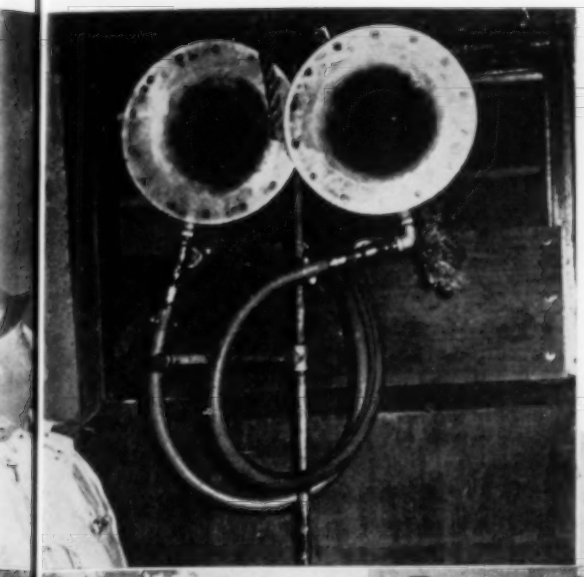
WHEN Edward Lamb was retired from the San Francisco Fire Department, where he had been a captain, he was unable to get the smell of smoke out of his nostrils and since then has been on a continual busman's holiday, devoting all his time to devising better ways of fighting fires. He has been especially concerned with the development of apparatus that will make it easier to combat "tough" fires, the ones that are difficult to handle with standard apparatus. The outcome of his efforts is a new piece of equipment, the Airmatic Task Unit, which puts compressed air at the disposal of firemen.

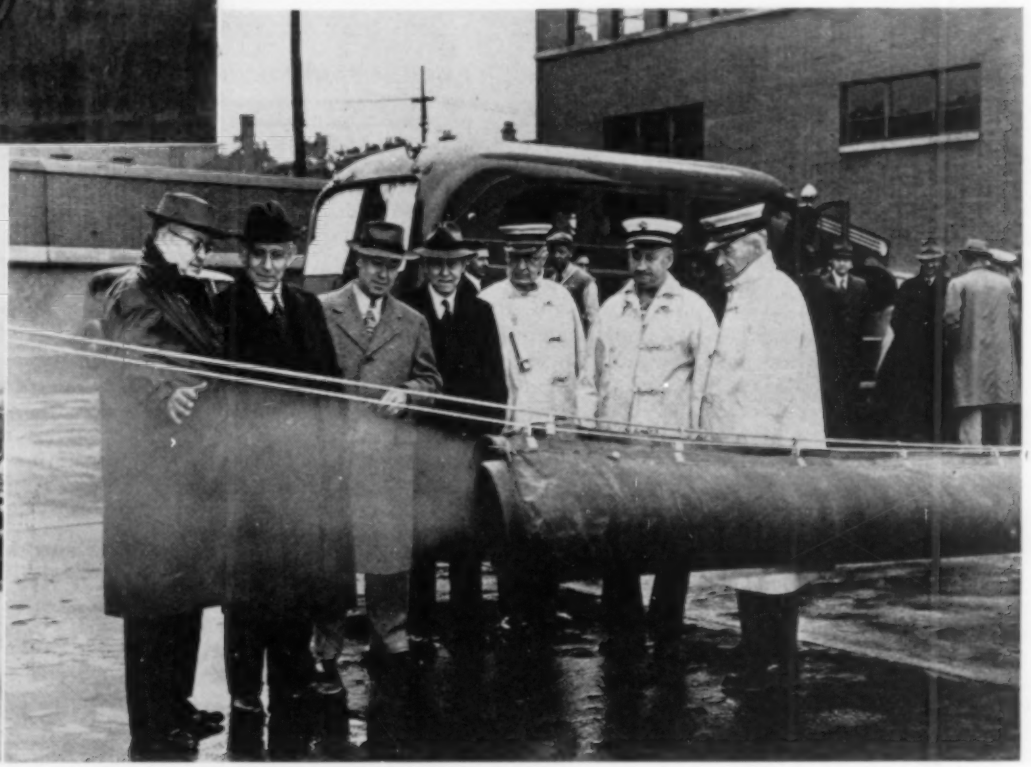
The Cincinnati Fire Department has had one of the units in service for two years, having procured it upon the recommendation of its chief, Barney Huston, who, incidentally, suggested the name Airmatic. It has been used to such advantage there that Mr. Lamb believes that other cities would benefit by its adoption. As a means of acquainting municipal authorities with the apparatus and other innovations, he has written a book that he hopes to publish and distribute, and it is from his manuscript that we have gleaned the facts presented here.

The investigations that resulted in Mr. Lamb's invention began some years ago when he visited the scene of a disastrous fire in the Franklin Street Tunnel in Chicago. The bore was being driven under the Chicago River by the water department when the blaze broke out. Almost insurmountable difficulties were encountered, and several firemen were overcome by smoke and lost their lives. Mr. Lamb had previously displayed an inventive turn of mind, and Chief C. J. Brennan of the San Francisco Fire Department, who looked over the tunnel with him, suggested that he devise equipment for the prevention of similar tragedies. Mr. Lamb thereupon began the study of fire fighting, which has been his principal interest in life ever since.

One of his first conclusions was that fire can be stopped if the travel of heat can be interrupted. This was not a new discovery, for many authorities on fire fighting had known that fact for a long time. They had likewise known that persons in a burning structure are relatively safe in many cases if they stay in a room that the fire has not yet reached and keep all openings closed. Heat rises, expanding the air, and as soon as doors are opened smoke is forced in and there is immediate danger of suffocation. When a fire broke out on the mezzanine floor of the St. Francis Hotel in San Francisco, intense heat traveled up the stair well to the fourteenth floor. A number of women employees were asleep on the thirteenth floor. One of the fire-department officials ordered the telephone-switchboard operator to call and tell them to stay in their rooms and keep the doors closed. They followed instructions and the fire was brought under control without any of them being injured or affected by smoke.

Mr. Lamb began experimenting with smoke ejectors and eventually designed one, known as the Lamb air mover, that





THE AIRMATIC TASK UNIT

In the lower central view, members of the Cincinnati Fire Department are posing in front of the special truck that was constructed along lines suggested by Edward Lamb. Air-operated tools shown are: a pavement breaker, a Jackhamer rock drill, a clay digger, and a circular saw. The hand tools are wire cutters and three types of jacks. Chief Barney Huston is standing next to the end, on the right. Left of him are visible the air-line take-offs from the receiver inside the truck. In addition to the pneumatic equipment, the truck carries miscellaneous supplies and materials for fire fighting and emergency service. At the left are two 6-inch Lamb air movers installed in the smoke room of the Cincinnati Fire College. They work on the principle of steam-jet ejectors, with compressed air at 100 pounds pressure creating the suction that draws smoke and heat into them. The two units can handle smoke- and heat-laden air at the rate of 10,000 cfm. Fires are regularly built in this room for experimental and training purposes. Firemen wearing helmets can enter and remain there when the air movers are operating, but are forced to withdraw as soon as they are shut down. The picture below shows heated air exhausted from the room being discharged outdoors through ventilation tubing. This photograph was taken during the official acceptance tests of the Airmatic Task Unit.

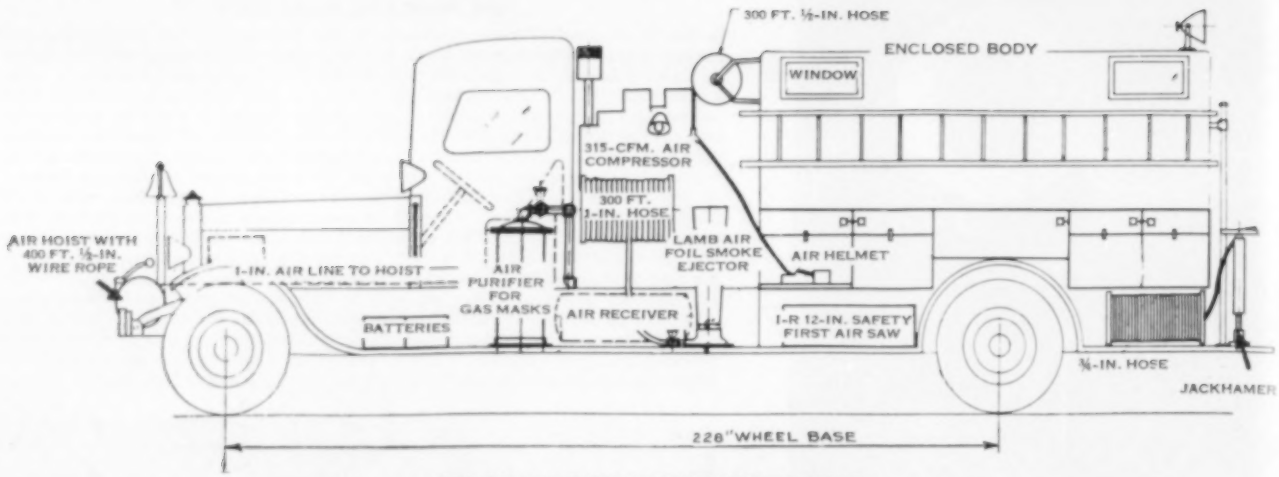
is suitable for the dual purpose of drawing off smoke and of preventing fire from spreading by stopping the heat from traveling. It is being used in many cities both in the United States and Canada and also by mining companies. Smoke ejectors have served fire departments for some years, the first one having been invented, reportedly, by a captain in the Sacramento, Calif., department. The Minneapolis, Minn., department made it mobile by mounting it on a 4-wheel chassis. A similar device stationed in Kenosha, Wis., was driven to the Franklin Street Tunnel fire in Chicago previously referred to.

The Fire Department of New York, according to Mr. Lamb, is provided with an ejector driven by an electric fan. The largest of this type has a capacity of around 3000 cfm., whereas the Lamb device will discharge 10,000 cfm. It is essentially a Venturi tube connected to exhaust tubing, and suction is induced by introducing compressed air, of which 400 cfm. at 100 pounds pressure is needed for a unit of the size just mentioned. The large volume it handles enables it to draw off heat, a function that was not performed to any great extent by the earlier smaller units.

Ejectors are useful not only for exhausting smoke and heat but also for withdrawing noxious and disagreeable gases that are often encountered on premises served by refrigerating or air-conditioning equipment. Many firemen and other persons have been overcome when such gases have been liberated by equipment breakage or flames. Ejectors are also employed to extract dangerous or flammable gases from the holds of tankships and other vessels.

Having determined that compressed air was a satisfactory medium for actuating large-capacity ejectors, Mr. Lamb continued to develop his idea of a self-contained, mobile piece of equipment carrying a compressor and various types of pneumatic tools. This, he reasoned, was in keeping with the trend in construction which has changed from low buildings of wood, plaster, and shingles to lofty structures of concrete and steel reaching 40 stories and more above the ground surface and three or four below it. During this transition there has been no great change in fire-fighting apparatus, except in pumping units.

Back in the 1840's, tubs of water were hand-passed, and the first steam pumping engine was built by Aherne in the 50's. Until around 1900 pumpers were all powered by steam, and they, as well as other apparatus, were pulled initially by men and then by horses. Next came gasoline-engine-driven pumps, which were looked upon at first with skepti-



ARRANGEMENT OF PNEUMATIC UNIT

Suggested conversion of a squad wagon or salvage truck as designed and patented by Edward Lamb. It carries everything in the way of air-operated equipment that might be needed, including a hoist. The latter is mounted on the front, and can be used for opening heavy doors, pulling down walls, moving stalled automobiles, etc.

cism, and the gradual disappearance of horses in favor of motorized equipment. Modern pumping engines deliver water at the rate of 250 to 1200 gpm. at 120 pounds pressure. Meanwhile fireboats also turned from steam to gasoline engines for propulsion and pumping, and some are now using diesel units.

Throughout these years the hook-and-ladder truck has remained essentially as it was when our forefathers pulled it with ropes in the days when fire departments consisted almost solely of volunteers. There are at present two general classifications of this apparatus—the city service type with ladders that have a reach of four stories, and the aerial type with 65-foot ladders. In the larger communities, one truck in every group of three is of the aerial type, and all are tractor-drawn. Most places big enough to be termed cities now have paid fire fighters, and Mr. Lamb estimates that the total number of paid and volunteer firemen in the world is 77,000.

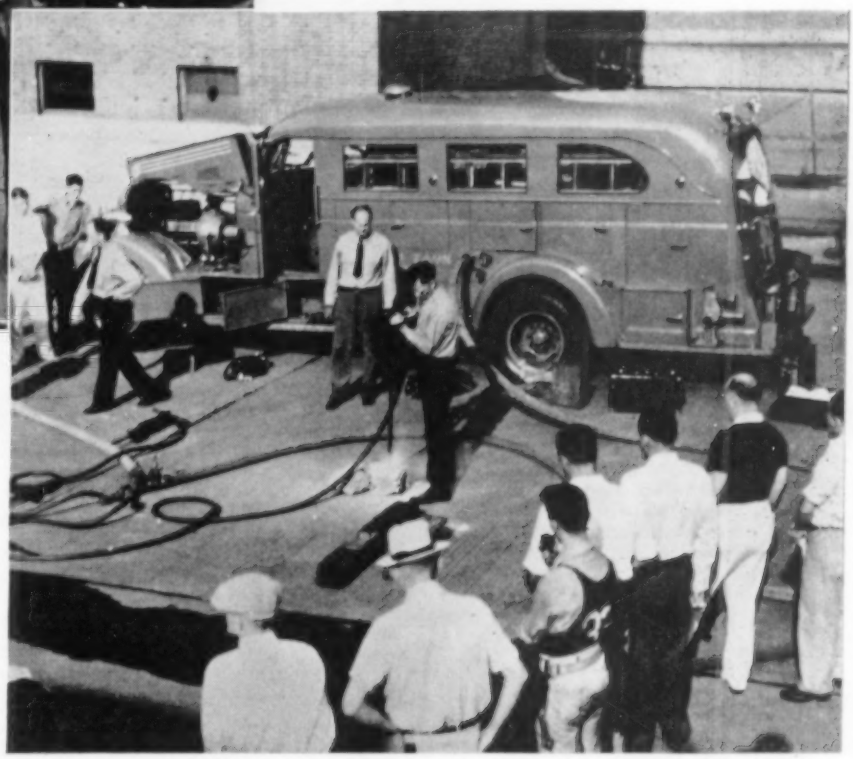
The growth of our cities and the tendency towards tall buildings with their banks of elevators, networks of electrical and communications wires, plumbing lines, ventilating and air-conditioning ducts, etc., have manifestly complicated the problem of fire fighting. In spite of the changed conditions, Mr. Lamb makes the observation that most firemen even in large communities are still using sledge hammers and chisels and similar hand-powered devices for cutting through concrete floors and walls to get their high-pressure hoses into basements and other advantageous locations. These operations come under the heading of "forcible entry" in the fireman's language.

In an effort to improve upon this procedure, Mr. Lamb investigated power-driven tools suitable for the purpose. He found that there is a complete line of air-operated equipment for performing just about every service that might be required. Some electrical tools also are available, but they present a safety hazard because of the likelihood of short circuits where firemen are working in water and wearing wet clothes. He therefore concluded that pneumatic equipment was best qualified for the work.

To use air-operated tools, it is obviously necessary to provide a compressor to furnish the power. For some years a number of cities, among them Chicago and San Francisco, have occasionally had recourse to pneumatic tools, but there has never been any intelligent program by which they could be utilized to best advantage. The compressors are of the portable type that serve public utilities, and the complement of tools is far from complete. Mr. Lamb visualized a compressor and tools in one self-contained unit ready for instant service, as fire-fighting equipment should be, and arranged for maximum efficiency. The natural course was to take some piece of apparatus that was already in use

EMERGENCY SERVICE

Cincinnati firemen re-enacting a scene that took place at a Kentucky summer resort where they recovered the body of a drowned girl from a lake. The face masks, supplied with compressed air, enable the men to breathe underwater. On fire duty, they are worn in smoky or gas-laden atmospheres.



USING PNEUMATIC TOOLS

In the picture below, a Jackhamer is being demonstrated to a class at the Cincinnati Fire College. The Airmatic Task Unit is in the background. Note that the fire hose is serving as an air line. At the left is shown a portable air saw cutting a 4x12-inch plank.

and to adapt it for this special purpose.

In the case of pumping units, the engine that drives the truck to a fire powers the pump after it gets there. Mr. Lamb reasoned that the engine on another piece of equipment could likewise be made to do double duty by driving an air compressor at the scene of the fire. He made drawings of this idea as applied to both types of hook-and-ladder trucks in general use and to a squad wagon or salvage truck. It is also possible to convert an old pumping unit for this service by substituting an air compressor for the pump. In any of these cases, the compressor is driven through V-belts, and changeover from propulsion to compressor operation is made merely by shifting gears.

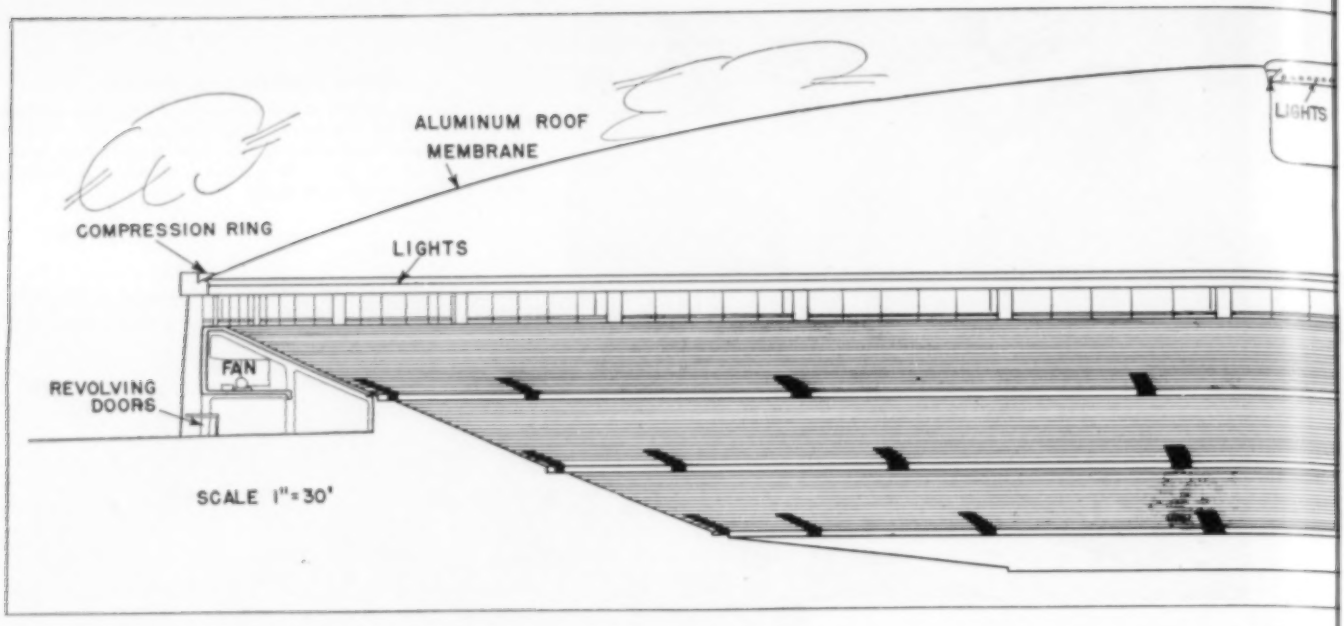
Because of the seasonal variations in temperature in many parts of the country it is advisable to use an air-cooled compressor because then there are no water jackets to freeze. Bearing in mind that most fire departments have had unfortunate experiences with "Orphan Annie" equipment for which spare parts could not be obtained when they were needed, Mr. Lamb recommends selecting standard types of compressors and tools made by a concern with widespread distribution facilities, adequate stocks of replacement parts, and a good reputation for servicing the equipment that it sells.

The Airmatic Task Unit now used in Cincinnati was specially built at a cost of around $20,000. Prior to its construction, a rescue and emergency squad truck had been in service for 25 years. The new unit is provided with equipment that was found to be useful during that period, together with pneumatic tools and compressed-air appliances that can be employed for various purposes. The compressor is an Ingersoll-Rand 350-cfm. machine, and the air-operated tools also are of I-R make. The latter consist of a Jackhamer rock drill, two pavement breakers for demolition work, a clay digger for breaking out semihard materials, and a circular saw that can cut to a depth of 4⅛ inches. Among the accessories are several sizes of Jackbits for the Jackhamer, various types of bits for the pavement breakers, and three different blades for the saw.

Other facilities that depend upon compressed air for their operation include four Lamb air movers of different sizes, several inhalators, and two face masks. The latter are supplied with air at 10 pounds pressure through reducing valves. Firemen wearing them can breathe freely in any sort of atmosphere, as well as underwater to depths up to 23 feet. The car also carries a wide assortment of tools, equipment, and supplies that experience has proved to be useful on fire and emergency calls. All these are stowed in numbered compartments where they are readily accessible.

The Cincinnati unit has been employed to advantage on numerous occasions. Firemen wearing the compressed-air masks have been able to carry the air movers to desired locations through smoke, thus aiding in clearing the atmosphere and permitting fire fighting to be carried on effectually. By reversing the flow of air, the air movers can be used for blowing instead of exhausting, thus enabling firemen to get close to flaming areas. The masks and air movers have given very good results in the case of breaks in refrigerating systems or in other emergencies where gases or chemicals have been released. They have made it possible to repair leaks quickly and to clear rooms or buildings of gases in a few minutes, thus reducing losses occasioned by work or business stoppages or by contamination of or damage to foodstuffs and other stocks.

On one occasion the masks enabled firemen to recover the body of a drowned person from a lake where trees and debris gave rise to difficult conditions. The air-operated tools have been used to cut through masonry or timber obstructions and for such services as making holes in ceilings or floors for water drainage. It has been stated that one man with a 35-pound pavement breaker can do as much work as seven men with hand tools. The pneumatic tools are especially advantageous in confined quarters such as on shipboard where there is not room enough to swing a sledge or ax.



SECTION OF STADIUM

A drawing by Plan-Tech Associates showing a section through the proposed roof enclosure at the 50-yard line (center) of the football field. As laid out, the domed, aluminum, membrane roof would be held in place by slight internal air pressure with its highest part 170 feet above the ground.

A Stadium with an

SERIOUS consideration is being given to the construction in Baltimore, Md., of a covered all-purpose stadium with a roof of sheet aluminum supported entirely by air pressure. The project calls for a structure large enough to seat 100,000 persons and suitable for year-round use. It is proposed to designate it as a state and city war memorial and to appoint for its administration a nonpartisan commission representing the religious, educational, business, political, sports, and cultural interests of Maryland. A General Stadium Committee of 78 leading citizens, divided into eight subcommittees for investigation of the various phases of the scheme, made a final favorable report on the project to Mayor Theodore R. McKeldin on May 1. This report will be supplemented later by additional engineering data and recommendations regarding the site.

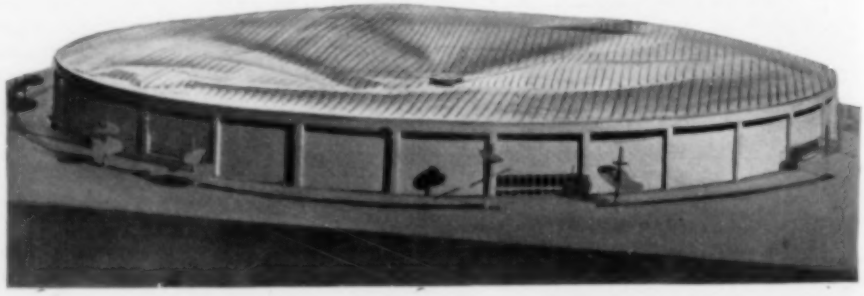
Present plans are for a structure that will inclose an area 900 feet in diameter and cover thirteen acres. The continuous exterior wall will be of concrete and will rise well above the highest of the seating stands. On top of this wall will be a compression ring for the attachment of the aluminum roof, with provisions for an airtight seal. Internal air pressure will flex the roof upward to form a dome, with its center 170 feet above the playing-field level. This will give sufficient clearance for baseball, football, and all other forms of sport. There will be 93,000 fixed seats arranged in the conventional banks and in the shape of an oval, plus 7000 portable seats that can be moved about as desired, depending upon the spectacle that is being staged. When not in use they will be stored under the permanent stands. Underneath the concrete seating structure will be ample space for the necessary operating machinery, offices, locker rooms, assembly rooms, a gymnasium, stables, kitchens and dining rooms, first-aid stations, toilets, etc.

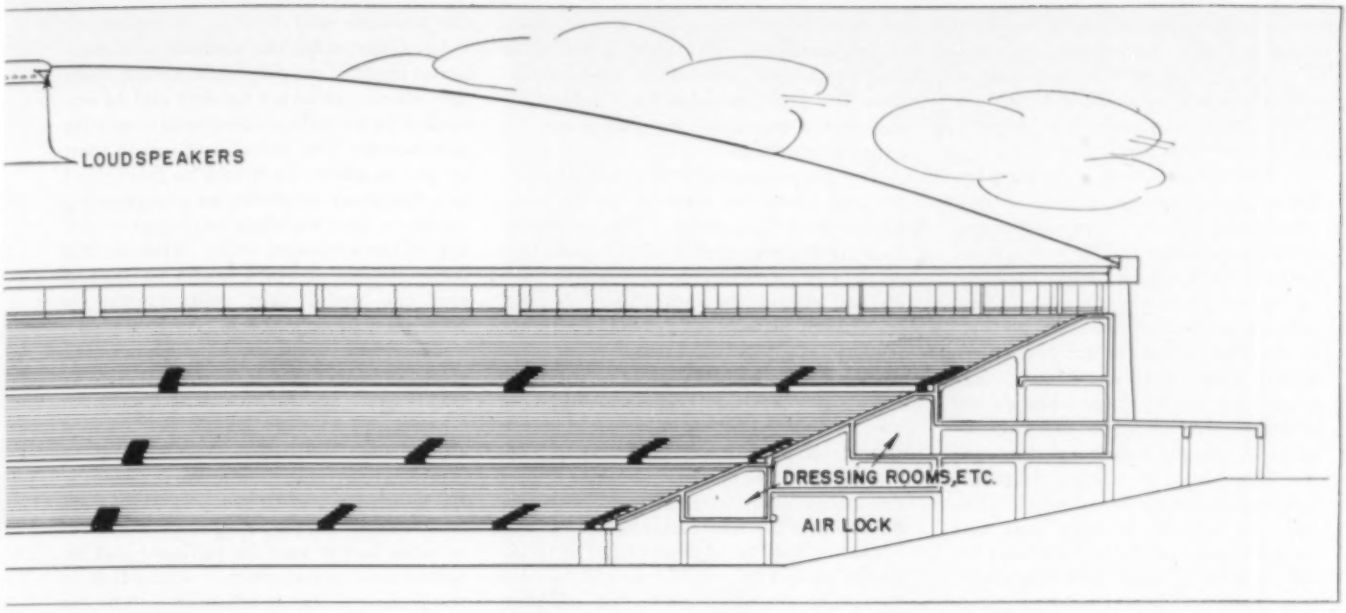
The idea of supporting a roof with air pressure is not new. In 1917, an Englishman named Lanchester suggested that structures of balloon cloth, inflated by blowers, serve as field hospitals during the war. A model was built and a large exhibition hall was designed on the same principle, but neither was actually constructed. Seventeen years later, John H. MacMillan, Jr., now president of Cargill, Inc., of Minneapolis, Minn., built a test cylinder with hemispherical ends of 30-gauge riveted steel sheets. The shell was 8 feet in diameter, and when the experiments showed that it could be kept rigid with comparatively low internal pressure, Mr. MacMillan designed and constructed a 70,000-bushel grain elevator without interior supports of any kind. In shape it corresponded to the longitudinal half section of the model cylinder.

The structure was 250 feet long, 50 feet wide at the base, and 25 feet high in the center. It was built of 22-gauge (0.0306-inch) galvanized steel sheets connected by brazing. This sheathing was erected over light timber falsework and then inflated. The design pressure was 70 pounds per square foot, but there were so many leaks at ground level that not more than 18 pounds could be obtained with the 7½-hp., 2-pound-per-square-inch compressor that was used. It became necessary to reconstruct the floor before the desired pressure could be maintained.

THE ROOF DEFLATED AND INFLATED

Pictures of a model of the proposed Baltimore structure that show how the floating roof will appear before and after air pressure is applied. Even without inflation it will hang well above the spectators' seats. Using ordinary ventilating fans, it will be possible to distend the roof to full height in 90 minutes, according to the engineers' figures.





Air-Supported Roof

Allen S. Park

From a structural standpoint the building was successful. It withstood heavy snowstorms and high winds without difficulty. When the air supply was cut off, several hours elapsed before the pressure dropped sufficiently to endanger the rigidity of the elevator. Its entrance was in the form of an air lock, it had double doors. The cost of the structure was very low for a grain elevator, being less than eleven cents per bushel of capacity. However, after it had been in service for about a year it was dismantled because the grain dust, which remained suspended in the air, presented an explosion hazard.

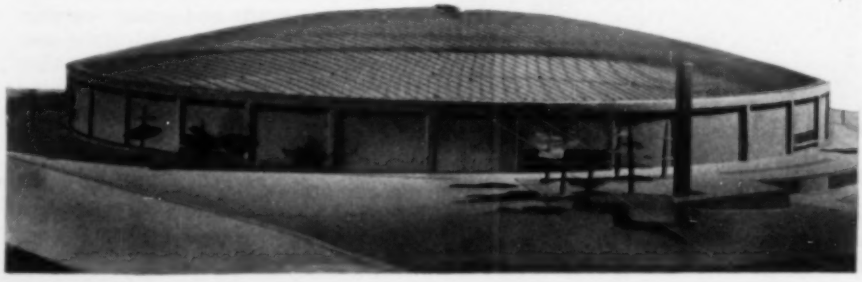
In 1942, while serving as a consulting research and development engineer for the John B. Pierce Foundation, Herbert S. Stevens became interested in applying the air-support principle to domed roofs of metal sheets. He conceived the idea of constructing the roof as a flat sheet and distending it beyond the yield point to give it a rounded form. Once it was arched in this manner the roof was to be supported by lower air pressure. He designed a 1200-foot-diameter factory building which was to have a roof of sheet steel 0.049 inch thick. Subsequently, a 300-foot-diameter circular structure was laid out by Joseph A. Wise, a member of the faculty of the University of Minnesota who had served as consultant to Mr. MacMillian during the erection of his grain elevator. For the latter building, with a roof of 22-gauge steel sheets, the pressure required to dome the flat surface was computed to be 40 pounds per square foot, while the normal pressure needed thereafter to hold it in shape and stretched tight was figured to be 20 pounds per square foot.

To obtain test data applicable to such a structure, experiments were conducted with a 12-foot-diameter model at the College of Engineering, New York University. This research work was sponsored by the War Production Board, with Mr. Stevens as project manager and Mr. Wise as director of tests. The investigations proved that a flat roof could be pushed up to form a dome and that it could thereafter be supported by air pressure. A basic patent covering the air-supported roof was granted last August to Mr. Stevens, who is now a consulting engineer in New York City.

Reporting on the model tests in the November 30, 1944, issue of *Engineering News-Record*, Mr. Wise wrote: "Unsymmetrical loads, amounting to about 600 pounds of lead in bags, where placed to simulate various unfavorable loading conditions and the accompanying stresses determined by strain gauges. Even at very low air pressures the model sustained these loads with very little deflection." These experiments, together with others with a smaller model in a wind tunnel, led to the conclusion that "such roofs, when properly designed, can resist snow and wind loads without difficulty."

The idea of applying the principle of air support to the roof of the proposed Baltimore stadium was conceived by Glenn L. Martin, the airplane builder, who served as chairman of the subcommittee on research and survey in collaboration with his assistant, Jan Porel, who was called in by the general committee to act as consultant. Mr. Stevens provided the data pertaining to the design and construction of the roof, while the general features of the building such as layout, seating arrangements, etc., were contributed by Martin and Porel.

Because steel sheets are vulnerable to attack by corrosion, it is proposed to use aluminum, which has the added advantage of being lighter. It has been computed that a pressure of only 9 pounds per square foot (approximately 1 ounce per square inch) would in that case suffice to support the huge roof of the stadium, as compared with 20 pounds for the same expanse if made up of steel sheets. That pressure is so low that it would have no physiological effect upon persons in the enclosure; in fact, they would not be aware of it. It



could be induced by ordinary fans of the ventilator type. In response to a question from this magazine regarding the pressure needed, Mr. Stevens wrote:

"The pressure required is based on three major considerations:

1. The pressure needed to support the weight of the roof and the equipment hung from it. The aluminum alloy (approximately ⅛ inch thick) being considered for use in the proposed stadium weighs about 1½ pounds per square foot. In the case of the 300-foot structure for which model tests were conducted, the weight of the steel membrane, insulation, and roofing material is about 5 pounds per square foot.
2. The pressure needed to resist down drafts and gusts of wind. This depends on the location and the relative sizes of other buildings in the vicinity. The proposed stadium is so large and would need so much space around it for parking that it is unlikely there would be any tall buildings near it to create gusty conditions.
3. The pressure needed to stress the material in the roof to prevent rippling and to resist concentrated loads. The tension in the roof will vary with the square of the roof's radius of curvature and so, on geometrical grounds alone, the stadium would require but a fraction of the pressure needed for the smaller structure.

"There are several minor factors, such as climate, operating conditions, etc., to be considered. Engineering judgment plays some part, but in the actual structure, the pressure could be adjusted for the best compromise by regulating the exhaust openings."

The plans specify that spectators enter and leave the stadium through ordinary revolving doors. The engineers state that these would offer a sufficient air seal to maintain the pressure at such a stage with all the ventilating fans shut off that it would take three hours for the roof to lose its tension and more than a month for it to settle. Provisions have been made to ventilate and cool the enclosure in summer with conditioned air circulated by blowers. This blower air, it is claimed, would support the dome even with all the revolving doors open for free exit. Based on this consideration, it is expected that a capacity crowd of 100,000 would be able to vacate the stadium in five minutes.

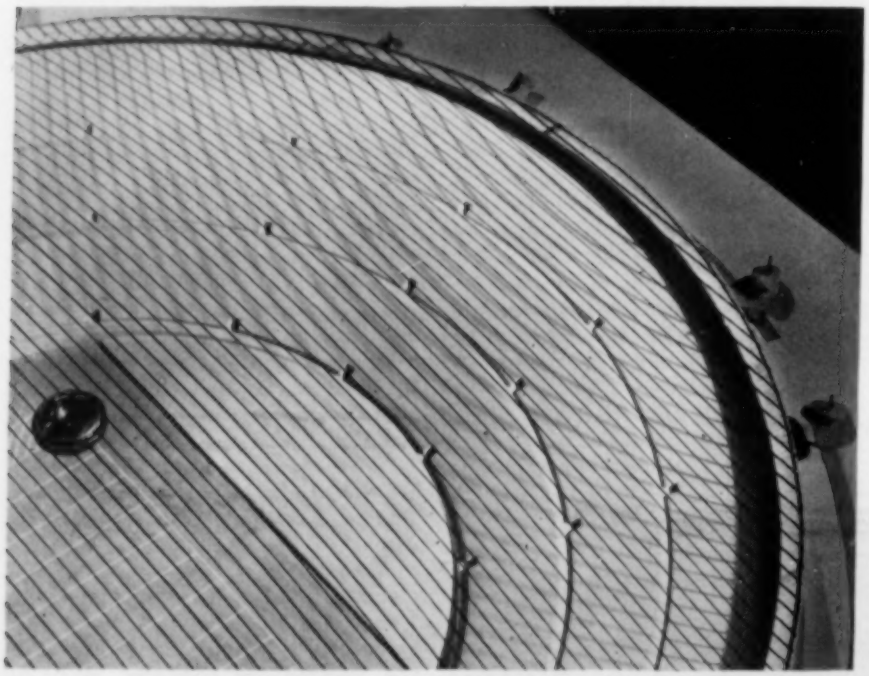
The plans also include a heating system for winter comfort. In the event of snowfall, the heat would be turned on and would melt the snow on the roof at the rate of ¾ inch per hour. Even without this feature, however, it is the opinion that snow would not be a serious problem. The excess pressure normally maintained in the stadium would support 5 pounds per square foot and would automatically be increased to 10 pounds—the equivalent of about 12 inches of snow—if the roof should start to settle. Additional controls would make it possible to speed up the fans and increase the pressure still further, if necessary.

In constructing the stadium, it is proposed that the seating facilities and their appurtenances be set up first and be encircled by an independent wall structure of concrete. The metal roof would then be put in place. It would be fabricated as a flat sheet, probably on a supporting platform, and its edges anchored to the top of the enclosing wall. With all this done, the air pressure would be applied and the metal skin pushed into its permanent domed shape.

The basic purpose underlying the stadium movement is the renascence of Baltimore. In the words of Chairman Charles P. McCormick of the general committee, "Baltimore stands today at a civic crossroad. There is no avoiding the truth that until recently Baltimore was being outrun by a number of younger cities in the race for national and international prominence." According to the planners, the structure should be the first of a series of efforts by the city to regain its place in the sun. It is expected that the enclosure would attract big sports events, national conventions, and other spectacles of national prominence and that it would automatically stimulate the building of hotels to accommodate visiting crowds.

Though sports and concessions would in all probability carry the operating costs, the stadium would undoubtedly be put to many other uses. Whereas an open structure might, with good luck, be filled fifteen times a year, a covered one, usable the year round and suitable for all kinds of activities would, reasonably, prove to be a profitable investment. Because of its ingenious design, the building could be readily adapted to house all manner of attractions such as circuses, conventions, ice carnivals and ice-hockey games, stage presentations, as well as grand opera. In addition to the provision that permits moving some of the seats, arrangements have been made to partition off sections of the huge enclosure whenever that might be desirable.

No site has as yet been selected for the stadium, but the committee has recommended that, for most effective use, it should be built outside the city limits where ample parking space is available, preferably near a dual highway. It is the aim of those interested in the project to finance its construction through outright grants of city, state, and Federal funds and lands, together with contributions from industries and individuals, because it is the belief that it could then be operated on a paying basis. The committee has suggested that the profits be spent in improving the health of the boys and girls of Maryland. It was pointed out that the Baltimore school-system budget now provides only $10,000 annually for a physical-fitness program.



LOOKING DOWN ON THE MODEL

A section of the roof showing how multiple strips of sheet aluminum will be joined together to form a canopy over the 13-acre, circular stadium area. The object that looks like a button at the left indicates the center of the dome, from which lights and loudspeakers will be suspended.

A Modern Noah's Ark

R. G. Skerrett

"Old Noah he built himself an ark,
There's one wide river to cross!
He built it all of hickory bark,
There's one wide river to cross!"

SO RUNS the collegiate lyric of rollicking, endless verses. But the ark with which we are at present concerned was never afloat on a flooded world. This ark has been adapted from an abandoned railway station to meet the artistic needs of Louis Paul Jonas, a sculptor, and occupies a site about 40 miles north of New York City on a branch of one of America's great trunk-line systems.

The Noah's ark of our toyland days was filled with small wooden animals that only crudely resembled the living creatures they typified, but to the childhood mind they helped to entertain and in a measure to inform. But the miniature animals that Jonas creates are strikingly lifelike in form, coloring, and posture—suggesting animation even though they lack it—because of the amazing skill of the artist.

A short while ago, a varied collection of 67 small-scale models of the world's wild mammals made by Jonas was exhibited in Roosevelt Memorial Hall of The American Museum of Natural History, New York City, where they delighted thousands of youngsters as well as many mature people capable of appreciating the arresting charm of the reproductions as well as their educational value. The exhibit was the outcome of years of patient work and accumulated knowledge. Numerous as the models were, they were diminutive examples of only one-third of all the mammals in the world; and it is the sculptor's ambition some day to complete the group.

Why has Louis Paul Jonas focused his talent on this special field of art? The answer is that the circumstances of his life since he came to this country in 1908 have, step by step, led him to this line of effort. This genius was born in Budapest, Hungary, in 1894; and when he was but eleven years old he began the study of sculpture. Three years later he was sent to America to join his brothers, who had established themselves as taxidermists in Denver, Colo., close to a region where wild animals of many kinds are hunted. His brothers were experts in their craft, and the youthful assistant acquired at first hand a knowledge of the anatomy of the creatures preserved by them. He also noted how the underlying muscles and tendons, either in repose or tension, affected the surface of the skin and told something of the story of the moment.

While still in his teens—in 1913—Louis Paul Jonas went to New York to work under the famous big-game hunter Carl Akeley in The American Museum of Natural History, where he remained until he enlisted in the U. S. Army during World War I. It was while he was at the Museum that the original Akeley African Hall and the African elephant and other groups were constructed. Jonas rejoined the institution in 1926 to mount the Indian elephant group and other exhibits for both the South Asiatic and Akeley African Halls—such had become his proficiency. However, feeling the urge to broaden his field, he left The American Museum and began creating

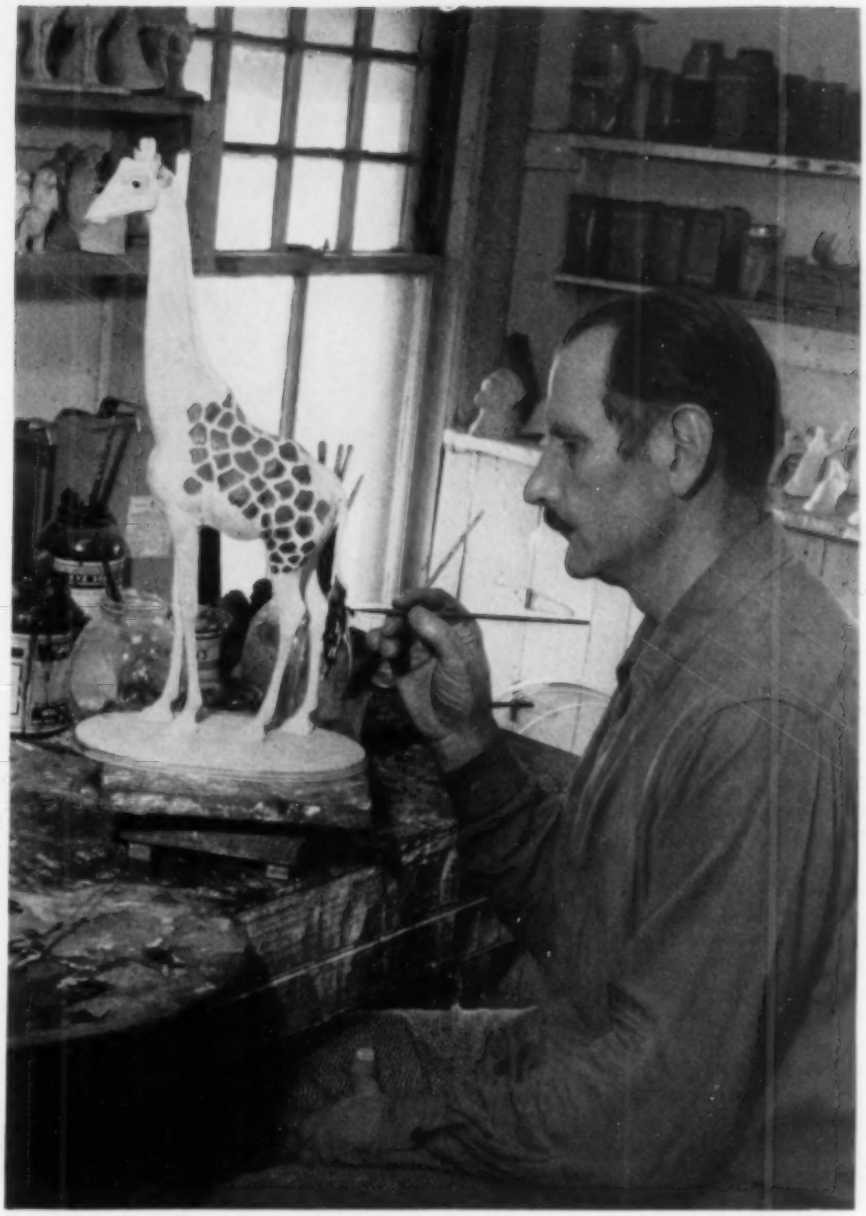
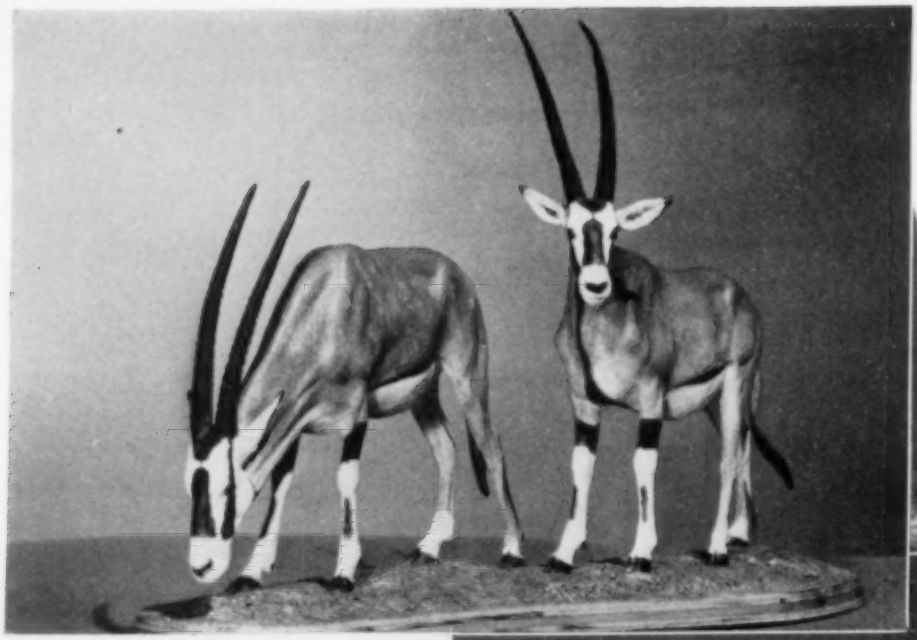


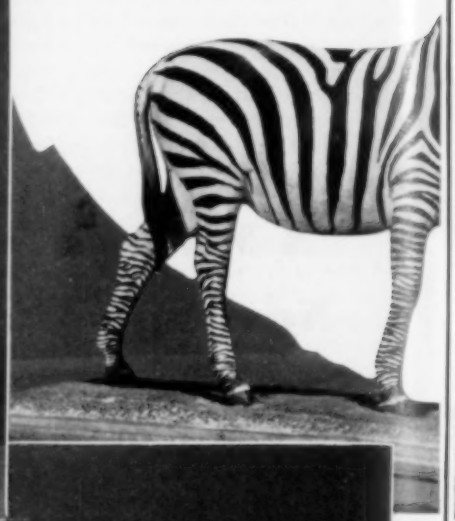
Photo by Edwin Way Teale

THE SCULPTOR AT WORK

The painting of the animal replicas is done entirely by hand and in painstaking fashion. This picture shows Louis Paul Jonas putting the spots on a miniature giraffe. The models are cast in molds with the aid of compressed air.



Photos, American Museum of Natural History



sculptural pieces such as "The Grizzly Bear's Last Stand" erected in front of the Denver Museum; habitat groups for both the Philadelphia and the California Academy of Natural Sciences, the Chicago Museum of Natural History, and for various smaller museums; as well as works for private collections.

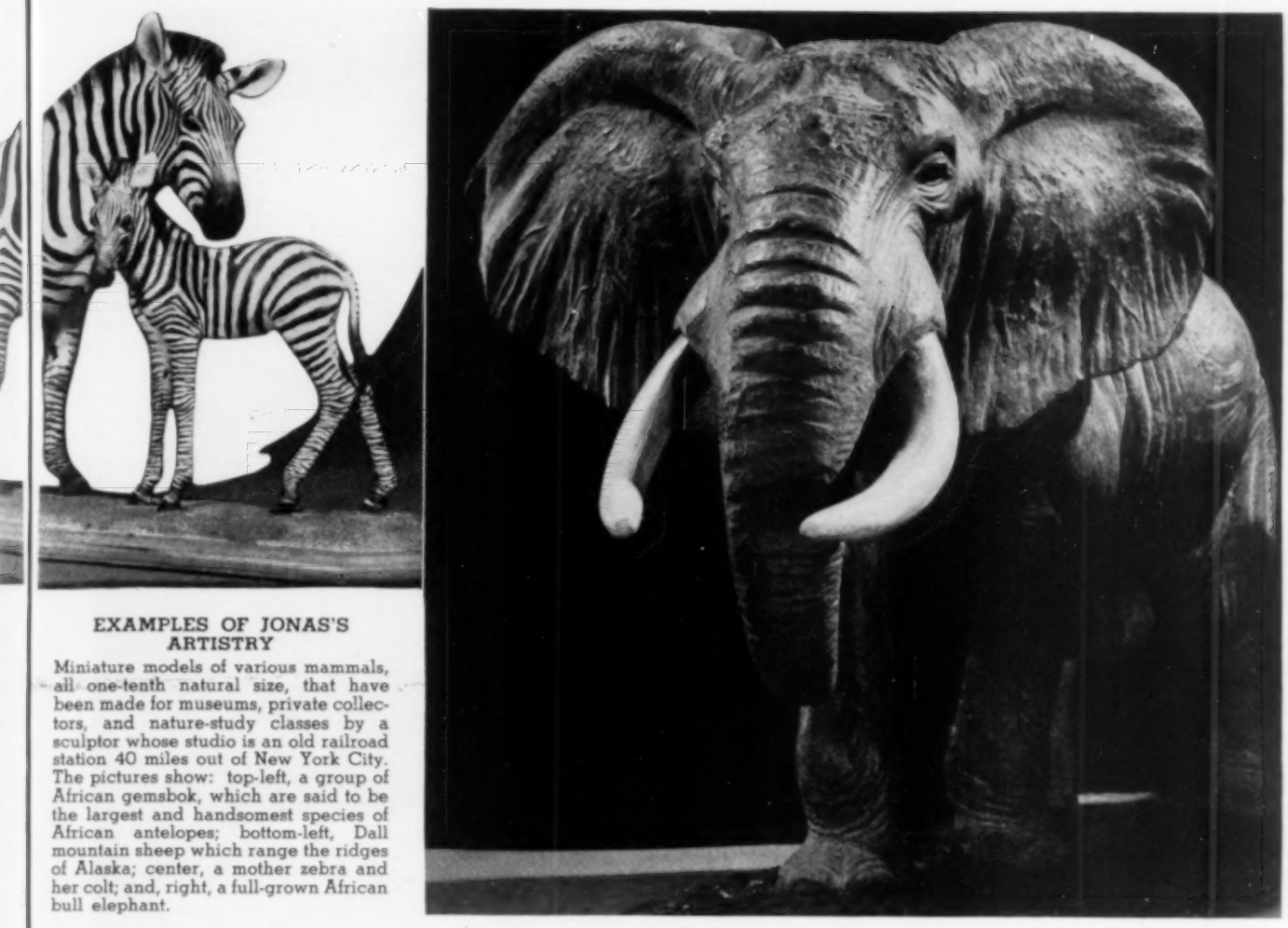
It was while he was first working for The American Museum of Natural History that Jonas met the then Col. Theodore Roosevelt who had chanced to see a modeled lion's head which the young man had hastily fashioned from the clay which it was his duty to keep in proper condition for ready service. Colonel Roosevelt was impressed and asked to see Jonas, who was reluctant to meet the great man. As the sculptor recalls the occasion: "He told me I was 'destined for big things.' And now I am doing little things!" With his success in big things it is reasonable to ask: Why does Jonas now concentrate on modeling animals in miniature? The American Museum of Natural History thus explains the change:

"Some ten years ago he began to reproduce in scale miniatures of the outstanding wild life of the world. What started as an interesting workshop hobby soon became a full-time job in supplying numerous requests for the miniatures. Natural-history museums for children, schools, colleges, universities, and institutions for the blind have used them as 'third-dimensional pictures' in natural-history studies, in miniature habitat groups, and in more highly specialized exhibits on comparative anatomy. Because so many of the models are handled by children, Mr. Jonas developed an unbreakable plastic composition after years of experimenting with different materials. Delicate horns and long tails, being made of latex, are flexible and non-breakable."

The recent exhibit of small models of mammals in Roosevelt Memorial Hall ranged from the great African elephant down to the tiny mouse, and included the elk, walrus, polar and grizzly bears, mountain goat, rhinoceros, hippopotamus, giraffe, lion, tiger, gray wolf, and the less familiar gnu, oryx, impala, takin, serow, dik-dik, bongo, and other animals of which most of us know but little. Each is on a scale of one-tenth natural size, and this makes the contrast between the elephant and the mouse more striking because both had to be modeled with the same degree of dimensional precision and form.

The manner in which Louis Paul Jonas has transformed the 2-story frame railway station is interesting because of the resourcefulness he has shown in adapting it to his needs. What used to be the cubby of the ticket agent now serves as his office, while the waiting room has become the studio, and the baggage room is well suited for the storage of models that have been produced and that are far more numerous than the ones that were displayed in the aforementioned exhibit. The second floor is utilized as a showroom and a record room where are filed for instant reference an array of photographs and data that are almost encyclopaedic in their scope. This fund of information, accumulated over the years, covers anatomical records, motion pictures of many animals, and other materials that could possibly aid the artist's memory and trained eye in doing the work to which he has dedicated his talent and his facile fingers.

To reproduce the living creatures on a one-tenth scale, Jonas has to resort to extremely fine measurements, for otherwise any error would be emphasized accordingly. The first step involved in creating a model of a chosen animal is that of fashioning a miniature figure of



EXAMPLES OF JONAS'S ARTISTRY

Miniature models of various mammals, all one-tenth natural size, that have been made for museums, private collectors, and nature-study classes by a sculptor whose studio is an old railroad station 40 miles out of New York City. The pictures show: top-left, a group of African gemsbok, which are said to be the largest and handsomest species of African antelopes; bottom-left, Dall mountain sheep which range the ridges of Alaska; center, a mother zebra and her colt; and, right, a full-grown African bull elephant.

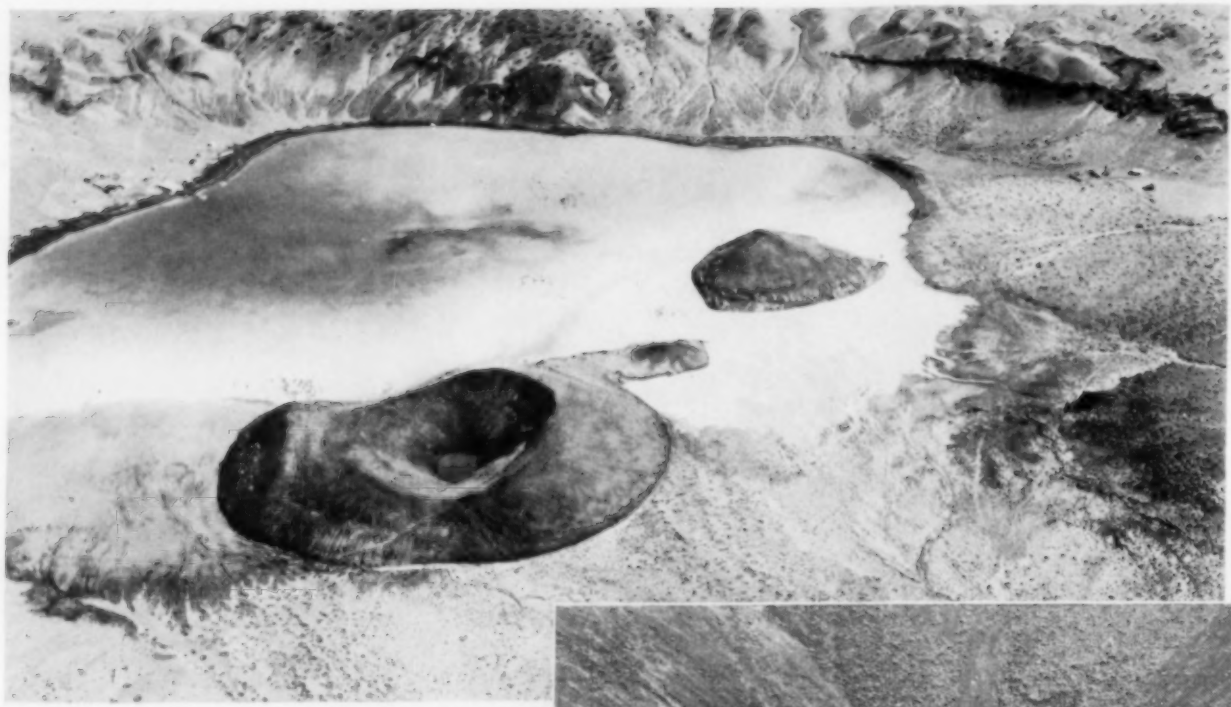
clay or plastelene patterned after a rough sketch drawn to the desired scale. The sculptor may take as much as two weeks to turn out a model that satisfies him and that has the desired characteristic poise, even though the purpose is to give the impression of motion at a chosen instant. Minute changes are made as the work advances, and precise measurements are taken and checked with those that have been made from life and recorded in the voluminous notes that Jonas has made from time to time. This deliberate procedure is the very opposite of the way in which models are so often turned out on a commercial scale of semimass production.

With the master model finished, it is embedded in a plaster mass that is divided as the work proceeds so as to form a mold of several parts. When the mold has hardened sufficiently it is opened and the clay model withdrawn. The next step in the process is to reassemble the parts and to make the mold ready for filling with the latex which the sculptor developed for the purpose after some years of persistent research. There was no suitable casting material available when he started out to make animals in miniature; but the latex he uses today meets all his requirements. It is fluid enough to be forced into even the smallest of the channels or cavities within a mold under the push of compressed air, which does not exceed a maximum pressure of 15 pounds per square inch.

When the plastic within the mold has hardened the necessary degree, the split mold can be opened to remove the cast, which is then carefully examined for imperfections. Next are trimmed off the thin "fins" that form along the joint or joints where the parts of the mold meet when held together during the injection of the latex. Even on a one-tenth scale, a full-grown giraffe is a sizable thing, standing as it does, when completed, quite 20 inches high above its base. The model of an adult African bull elephant, on the other hand, presents a striking contrast in mass because it calls for nearly a dozen pounds of plastic to fill the mold, while a field mouse, also diminished to one-tenth its normal size, requires considerably less than a thimbleful of latex to give it form.

When everything is to the artist's satisfaction, the cast is ready for the final operation—for painting—to give the little creature the coloring and distinctive markings with which its full-size, living counterpart is endowed. The brush work is another test of Jonas's versatility. Even though an admittedly skillful sculptor, he might fail in the end if his color sense were not sufficiently keen to enable him to simulate the coat with which his subject has been cloaked by nature as a means of protection in its habitat. But Jonas does not falter in this work, and that is why the miniature animals that he sends forth from his unique Noah's ark at Lake Mahopac are so highly valued for educational and scientific purposes. The clay models around which the molds are formed, as well as the molds themselves, are retained and used from time to time to turn out additional replicas; but the final painting must always be done by hand and with patient and close attention to the colors and patterns set by nature.

To adapt his models for use in schools, Jonas has devised portable boxes in which characteristic groups can be set up and made to appear even more lifelike because the interiors of the cases are painted to simulate the natural surroundings of the particular creatures on display.



U. S. Soil Conservation Service photo

New Mexico's Crater Lake

Where Nature Provides a Perennial Salt Crop

E. R. Harrington

GENERAL VIEWS

The aerial view at the top shows the lake and the cinder cones, the near one of which is the source of the saline water. The buildings where the salt is prepared for shipment are visible on the opposite shore of the lake at the upper left. The lower picture shows the brine pool as it appears from the top of the crater in which it rests. It is about 200 feet in diameter and said to be not more than 23 feet deep.

THERE are several crater lakes in America, the most famous one of course being that in Oregon's Crater Lake National Park. New Mexico, not to be outdone in her share of volcanic phenomena, also has a crater lake. While it is not so large as its northwestern brother it is unique in being the only crater lake in the United States filled with salt water. It is in the west-central part of the state some 50 miles south of the Indian capital of Gallup. There, surrounded by civilizations which were ancient when Columbus discovered America, lies the No. 1 Indian "salt lick," the "daddy" of all its kind.

You catch the first glimpse of the lake from its northern shore. There it is, a shallow, greenish-gray body of water in a steep-sided bowl something over a mile across and about 300 feet deep. The bowl's rim is an almost unbroken band of black lava. In the southern part of the lake are two cinder cones that rise to a maximum elevation of perhaps 200 feet, the higher one being completely surrounded by water and the other one being tied to the southwest rim by a black cinder slope. On the northern shore is a boat landing where a number of flat-bottomed scows lie in readiness for the harvest which takes half a million pounds of salt from the shallow waters every year.

The two cones are perhaps the most interesting features of the lake. The higher one is solid, its throat being completely choked by cinders; the other, which covers a larger area, has a crater in which is a pool of clear salt water of an amazing greenish color presenting a beautiful sight in the steep-walled funnel of red and black cinders. The pool is some 200 feet in diameter, and as its bed is invisible it is reputed to be bottomless, as such bodies of water frequently are said to be. However, judging by the slope of the sides, it would seem to be about 30 feet deep. Dr. S. B. Talmage, of the New Mexico School of Mines, checked a reported depth of 500 feet and found it to be not more than 23. The level of the pool is a foot or more above that of the lake that has formed in the great flat basin surrounding the cone.

The water inside the crater is nearly completely saturated with salt. The brine wells up in the nature of a spring, and as the level of the pool is above that of the lake, the brine percolates through the porous cinder walls and finds its way into the larger body of water. The latter has a maximum depth of less than 10 feet, most of it being shallow enough for wading. Because of its shallowness it is subject to a tremendous amount of evaporation in the drier seasons of the year, in fact, the evaporation far exceeds the inflow of brine from the crater spring. The water in the lake therefore

becomes supersaturated, salt crystals forming on the bottom and interlacing to make an incrustation several inches thick.

One is immediately struck by an oddity such as a brine spring in a volcanic crater. The great flat basin is surrounded by Cretaceous sediments, and these are underlain in New Mexico by the Permian "red beds." The latter were laid down in a broad shallow sea, connected to the ocean by a narrow strait, far back in geological time before the dinosaur arrived on the scene. By progressive fillings, settlings, and dessications, this vast inland sea became a succession of beds of salt, gypsum, and sandstone, including the lesser deposits of potash salts that are found many miles away in southeastern New Mexico. In some places the red beds contain layers of salt that are as much as 2000 feet in thickness.

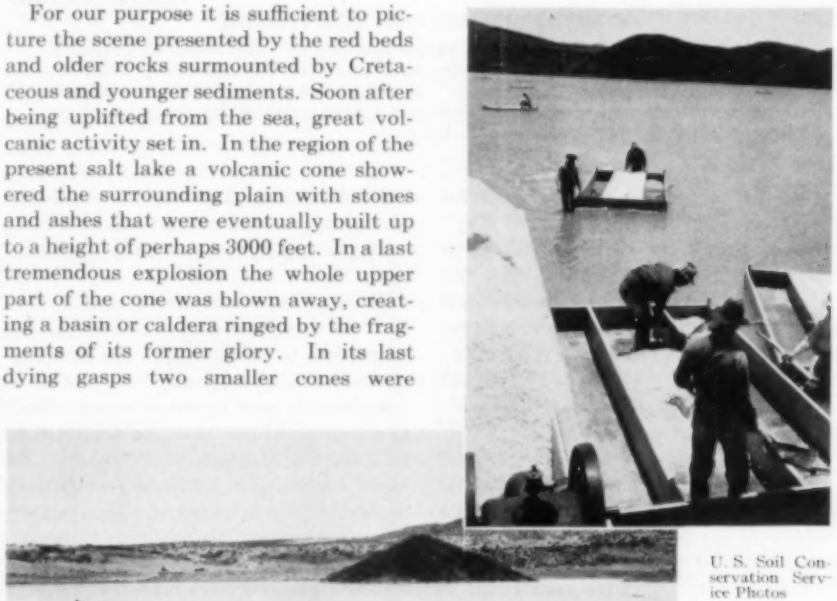
For our purpose it is sufficient to picture the scene presented by the red beds and older rocks surmounted by Cretaceous and younger sediments. Soon after being uplifted from the sea, great volcanic activity set in. In the region of the present salt lake a volcanic cone showered the surrounding plain with stones and ashes that were eventually built up to a height of perhaps 3000 feet. In a last tremendous explosion the whole upper part of the cone was blown away, creating a basin or caldera ringed by the fragments of its former glory. In its last dying gasps two smaller cones were formed within the basin, one filling its vent with cinders and lava and the other remaining explosive to the last, leaving a steep crater that was eventually to become the brine spring that is a source of salt today.

As the volcanic fury died away, the fissure connecting the lower volcanic magma with the active spatter cone became the conduit through which water rose to the surface. Like that in most springs, it is surface water—water coming from higher levels but taking a roundabout course which leads it far underground during its travels. Before rising through the vent it passes through the salt-bearing red beds and, accordingly, becomes nearly saturated with salt. This brine, as has already been mentioned, flows out through the porous cinder crater and becomes supersaturated in the shallow water outside.

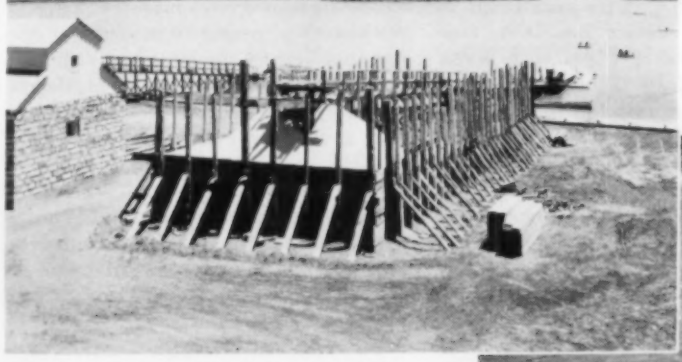
In early spring the harvest commences. Flat-bottom boats are poled out and anchored to posts driven into the lake mud. The workers wade in alongside, finding few places where the water comes above their knees. By skilful use of large, flat, many-tined forks they scoop the salt incrustation from the floor and place it in the boats, leaving it surprisingly free from the mud upon which it has rested. The loaded boats are poled to the dock where the salt is transferred to ore cars for a short journey up an inclined track. At the crest of the incline it is dumped in two large stock piles.

A block-making machine was installed a few years ago, but up to date most of the salt has been shipped out in crystal form. It is used chiefly for livestock and is delivered by truck to many ranches in Arizona, New Mexico, Texas, and Mexico. Actually the salt is quite clean and rather free from magnesium compounds as well. Very little if any refining would be needed to prepare the product for human consumption.

The Indians from Zuni Pueblo some 40 miles to the north have used this lake as a source of salt from time immemorial. When the Spanish explorer Coronado entered Zuni in 1540 that village had already built up a thriving salt trade with tribes far down in Mexico. Certain other warlike tribes made forays into Zuni territory for salt, but, even so, the lake was always associated with the Zuni Pueblo in ancient times. They made quite a ritual of their salt gathering. For that matter they do so today. A white-man's company owns the land now, but during the spring the Indians still come to harvest their salt and do so with the consent and the assistance of the present owners. The modern workers remove almost all the salt crust from the lake floor every year, and yet twelve months later another half million pounds lies there for the taking.



U. S. Soil Conservation Service Photos



TAKING THE HARVEST

Men remove the salt from the lake bed with forks and load it into flat-bottom boats (right). The latter are brought in by manpower (top) and the salt is unloaded at a dock. Note the outer compartments in the boats where the salt may be washed before being transferred to the central space. From the dock it is conveyed up a ramp and stockpiled (above) until it is sacked for distribution by truck to ranches in New Mexico, Arizona, Texas, and Mexico.

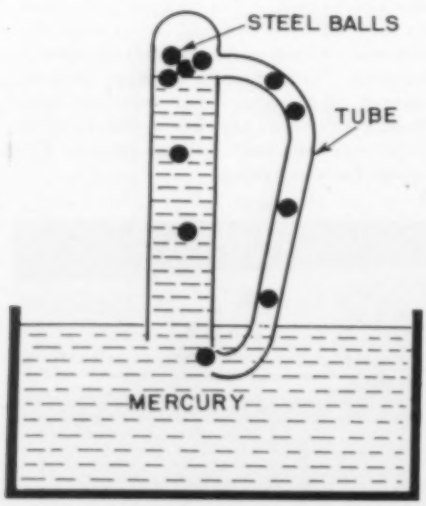
Something for Nothing

Robert Clark

IF A kettle of water be placed on the fire there is a chance, though an exceedingly small one, that the water will freeze. Impossible? Not according to the statement of the eminent physicist Planck. Furthermore, it might happen many times.

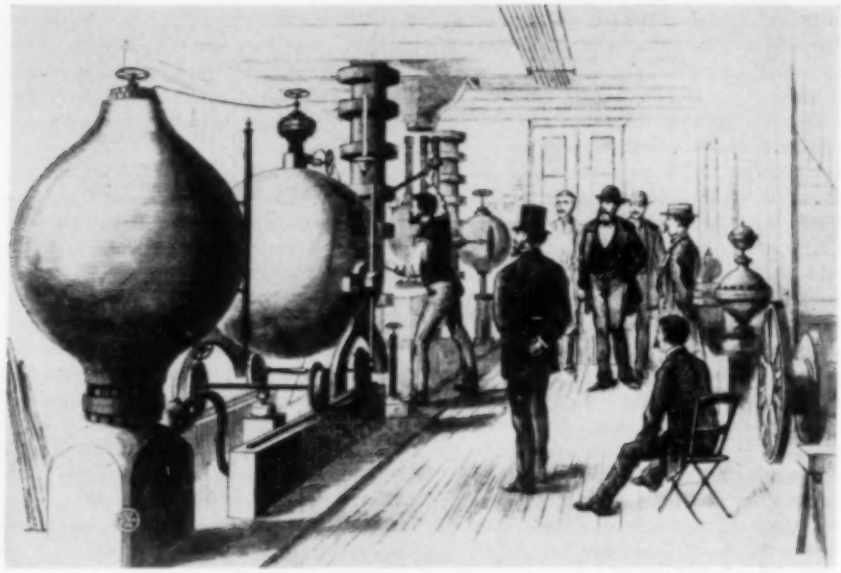
While the explanation of how such a strange reversal of a natural phenomenon could occur is beyond most of us, nevertheless, the statement makes one wonder if other "impossibilities" might not happen—perpetual motion, for instance. Now here is an idea so venerable, so crammed with associations, that even the most skeptical scientist has a tender feeling for the person who proposes some such device.

Briefly, a perpetual-motion machine would be a mechanism that could do some work and operate without any power other than it was capable of generating itself. Once set in motion it would continue to run forever—well, perhaps we should say "for an indefinite period," for who can tell when "forever" arrives? How hardy a perennial is the belief that perpetual motion can be achieved is shown by reports in the daily press. Someone is always breaking into print with an account of a new idea that will revolutionize the world of mechanics and provide leisure and freedom for the common man.



IT WORKS—ON PAPER

Theoretically, the mercury in the vertical column rises to the level shown, and the steel balls, being lighter, ascend the column, fall down the curved tube, and then make another cycle. Actually, mercury won't rise in the column unless the latter is under a vacuum; and, if it did, it would also rise to the same height in the curved tube.



Bettmann Archive print

COMPRESSED AIR WAS THE VILLAIN

A private test of the Kelly Motor, a "perpetuum mobile" that attracted considerable attention in the late 1870's. Posing as a wizard of "etheric force," John W. Kelly professed to utilize "free energy" to operate his mechanism. Investigation of the device after his death disclosed that it was actuated by compressed air conveyed to it through small hidden tubes.

The desire to obtain something out of nothing is not new, for the first authentic account of a serious consideration of the problem of perpetual motion is found in the sketchbook of an architect, Wilars de Honecord by name, in the year 1269. A drawing of the device has been preserved, and shows a wheel with seven mallets attached to the rim. Four of them always seem to be on the descending side while but three are on the ascending side. How Mr. Honecord proposed to keep his machine from flying apart—a condition certain to occur in any structure in which a greater number of parts is going in one direction than in the other—is not mentioned.

Along about the same time, one Peter Peregrinus took up the quest for the *perpetuum mobile*. He alludes to it in a bit of writing as the pursuit in which many had "wandered about wearied with manifold toil." This is most interesting, as it attests to the fact that the problem engaged man's attention from even an earlier period.

Little is known about the next 200 years concerning the activities of the perpetual-motion crowd until Leonardo da Vinci, in 1490, produced designs for six such machines. And after another lapse of 80 years the Jesuit priest Johannes Theisner believed he could perfect a contrivance of that kind by using a magnet to draw iron balls up an incline.

During the seventeenth century the idea of using capillary action instead of pumps to raise water was first suggested. Once the water was above its own level it was to drive water wheels of all sorts. About 1650, Edward Somerset, second Marquis of Worcester, devised a wheel that had many weights attached to its rim by cords. Once started, it was supposed to revolve "forever."

But it was the eighteenth century which furnished the brightest page in the history of perpetual motion, for during that period inventors of such machines flourished to a remarkable degree. Probably the most celebrated of these was a German-Pole, one Jean Ernst Elie-Bessler who, apparently not having enough names, assumed the surname of Orffyreus. He contrived upwards of 300 perpetual-motion mechanisms and seems at last to have hit upon one that worked. Kings, princes, professors, and learned men were all convinced of the absolute certainty of the machine's action.

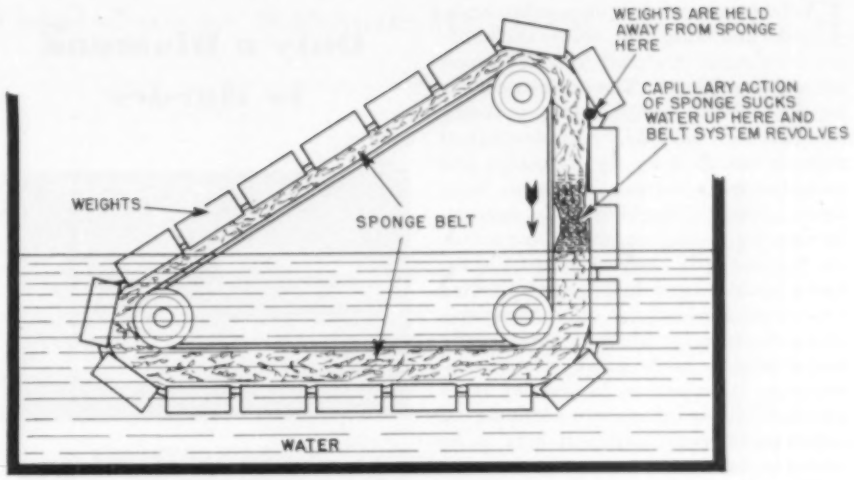
In a letter to Sir Isaac Newton, a Professor Gravensade gives a full physical description of Orffyreus's contraption. He describes it as made of "several cross pieces of wood framed together, the whole of which is covered over with canvas to prevent the inside from being seen. Through the center of this wheel or drum runs an axis of about three-quarters of an inch diameter upon which the machine turns. I have examined these axles, and am firmly persuaded that nothing from without the wheel in

the least contributes to its motion. The wheel turns with astonishing rapidity, and a cord tied to the axle turns an Archimedian screw which raises water."

Whether Sir Isaac Newton replied to this letter is not recorded, but we do know that, as in our own times, there were hecklers and disbelievers. Among others, we find a M. Crousaz writing: "First, Orffyreus is a fool; second, it is impossible that a fool can have discovered what such a number of clever people have searched for without success; and, third, I do not believe in impossibilities!"

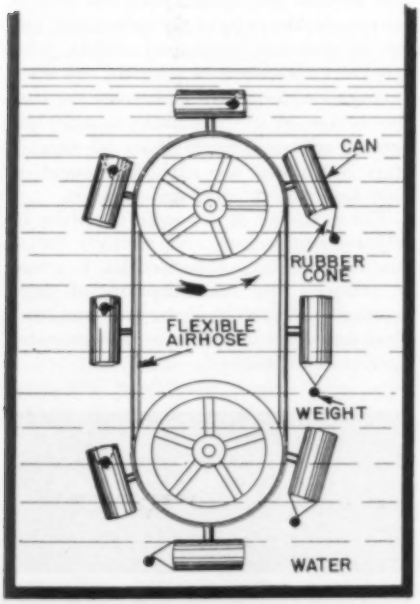
While the eighteenth century produced the most colorful perpetual-motion machines and inventors, it remained for the next century to give us the greatest number of fraudulent devices. Charles Redheffer in 1816 produced one which cost investors a great deal of money. Today, visitors at the Franklin Institute at Philadelphia may view it and ponder over its "logical" aspects.

In 1827, Sir William Congreve, the inventor of the Congreve rockets, conceived a perpetual-motion machine that was to work on capillary action. It was an ingenious contrivance and a great refinement over those first proposed some hundreds of years earlier. About 1890, an Armenian, Garabed Giragossian, turned a huge flywheel at high velocity by a small motor, then disconnected it and asked the congressional investigators to believe that more power had been developed than he had used in setting the wheel in motion—clearly an absurdity.


WEIGHTS ARE HELD AWAY FROM SPONGE HERE
CAPILLARY ACTION OF SPONGE SUCKS WATER UP HERE AND BELT SYSTEM REVOLVES
WEIGHTS
SPONGE BELT
WATER

ANOTHER UNBALANCED SYSTEM

This one was supposed to work in this way: Capillary action of the sponge draws water upward at the right and increases the weight of the belt, causing the system to revolve clockwise. On the inclined plane the weights squeeze the water out of the sponge. This illustrates the perpetual-motion machine advanced by Congreve in 1827.



A SUBMERGED SCHEME

This system was designed to run on the principle of unbalanced buoyancy. In one end of each can is a rubber cone with a weight attached to it; the other end is closed. In the course of a cycle, the cones on one side extend beyond the cans, while those on the other are inside the cans. Compensation for changes in air pressure is effected through the use of a hose that serves as a belt to which the cans are connected by tubing. Theoretically, the cans on the right contain more air than those on the left and therefore have greater buoyancy, thus inducing a counterclockwise motion.

Naturally, the question often arises, "Did any of these machines ever succeed?" Well, the answer is, "Yes!" About 1789 there lived in Shoe Lane, London, an ingenious jeweler named James Cox. He perfected a self-winding clock that took advantage of the rise and fall of a barometer to keep the weights wound up. It worked perfectly, as did countless other mechanisms which made use of slight changes in temperature during the day, or the cooling effect of the evaporation of water, to actuate them.

However, strictly speaking, none met the basic requirements of a true perpetual-motion device. For with the possible exception of the force of gravity, no other outside source of energy may be utilized in the operation of such a machine. Mechanisms that do depend on outside forces may be called perpetual-motion machines of the second order, as they work not by the creation of energy but by drawing upon free and universal sources of power that are ever-present and ever-obtainable.

Perpetual-motion's foe of course is friction—the rubbing together of the parts of the machine and also the resistance of the air or other elements to the moving parts. One of the factors which has deceived investigators in the past is that, if friction be slight, very little power may move a device for weeks or even months. Many have reasoned that as a wheel is reduced in size, friction is reduced in proportion. Therefore, by employing two in this ratio, they could eliminate friction entirely. This idea is like that of the man who, seeing a stove advertised to save half the usual quantity of coal, bought two in the belief that he could save it all.

Generally speaking, all perpetual-motion machines may be classed as frauds, absurdities, or fallacies. All of the fraudulent type depend upon concealed power. England had one so sensitive that it sneezed and swore when snuff was poured into it. Hidden sources of compressed air and concealed watch-driving mechanisms have been used to dupe the unwary. In the case of those that are clearly absurdities, little thought or study is necessary to see at once that they are impossibilities. But in the last group, those that fall under the heading of fallacies, we find a sincere attempt to accomplish the impossible. The inventors of such devices are as conscientious and hard-working a lot of men as can be found anywhere. But because they have never studied even the most elementary principles of physics and mechanics they unfortunately waste their talents on the ever-receding chimera of perpetual motion.

Many laugh today at the idea of anyone being taken in by the claims of a perpetual-motion inventor. But wait . . . just a few years ago—1938 to be exact—the Attorney General of the State of New York found it necessary to stop the sale of stock in a perpetual-motion machine! Such a recent example simply attests to the fact that man will never cease to try nor be discouraged in the attempt to find some process or machine that will give him "something for nothing."

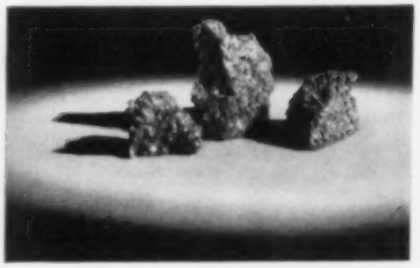
Only a Diamond is Harder

FROM two commonplace substances, coke and boric acid, comes the hardest man-made material yet developed for commercial use. The chemist calls it boron carbide (B_4C), while industry knows it as "Norbide," a trade-marked name given to it by its originator and manufacturer, Norton Company, Worcester, Mass. "Norbide" is of particular interest to the compressed-air industry because it is a superior material for lining nozzles used in pressure blasting with sand, steel grit, or other abrasives, an application for which it is especially suited because of its great resistance to abrasion. Conversely, in another of its principal fields of service—lapping or polishing of metal parts—it acts as an abrasive.

"Norbide" ranks second to the diamond in hardness, having replaced silicon carbide which, for 50 years, was the most indurate substance contrived by mankind. Its extreme hardness is the more astonishing when one considers that neither of the raw materials from which it is fashioned is hard. Indeed, one of them, boric acid, is a powder that can be crushed between the fingers and is so mild chemically that it is used in solution to soothe eye irritation.

"Norbide" was developed intentionally and not be accident, and the road was beset with difficulties. A combination of boron and carbon was effected many years ago, but it contained excess amounts of boron and some free graphite. Its chemical symbol was B_6C. It was not satisfactory as an abrasive because part of its content had abrasive properties and another part, the graphite, had lubricating properties. True boron carbide was finally produced in an electric furnace and is a crystalline compound containing some 99 percent boron and carbon and devoid of softer materials.

The boric acid used must be the purest obtainable and comes from Searles Lake on the edge of Death Valley, Calif. This body of water is so loaded with natural salts that it has a crust as strong as a layer of ice. The acid is shipped to the Norton plant at Niagara Falls, where low-cost electricity generated by falling water is available. The first step consists in driving the chemically combined water out of the crystals, a process that gives rise to a glass that is slightly harder than ordinary window glass. This is anhydrous boric oxide, which must be prevented from reabsorbing water or it will return to its original state.



NORBIDE CRYSTALS

As they appear when they are taken from the electric furnace.

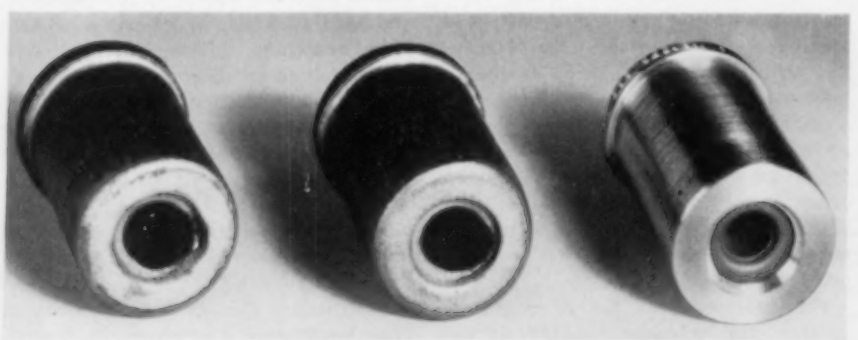
Accurately measured proportions of the glass and of the purest grade of petroleum coke are heated in a resistance-type electric furnace capable of producing a temperature of around 5000°F., or almost twice the melting point of steel. This serves to remove the oxygen from the boron oxide and to substitute carbon for it, forming boron carbide. The latter is fused (at 4440°) and then cooled to form beautiful crystals, which may be used as an abrasive just as they are but which are commonly made into two forms for the particular applications to which they are put.

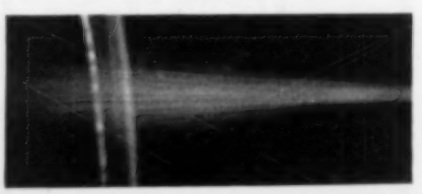
One of these products is a powder for lapping jobs that could previously be done satisfactorily only with diamond dust. In this category are the grinding and lapping of dies, cutting tools, and other objects made of cemented tungsten carbide and tantalum carbide. For these purposes the "Norbide" is crushed and marketed in various standard grain and flour sizes.

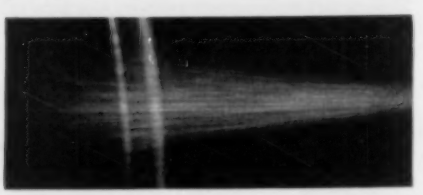
The second product is in the nature of molded forms made to accurate dimensions by subjecting the self-binding powder to great heat and pressure in special molds. Molded "Norbide" has many applications, and new ones are continually being found. One of importance in war industries is that in connection with plug gauges—solid and hollow cylinders cemented on metal shanks. There is a record of one such tool having tested the diameters of 630,000 holes with less than 0.0001 inch of wear. Contact points of micrometers and snap gauges likewise are sometimes formed of "Norbide" to insure sustained accuracy and to reduce the need of frequent checking.

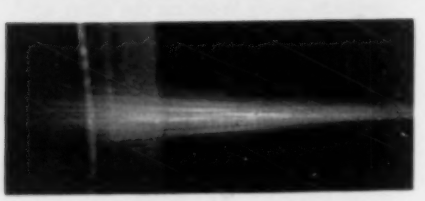
Pressure blasting nozzles lined with "Norbide" give truly remarkable service. Not only do they last hundreds, or even thousands, of times longer than former nozzles, but they also contribute to greater over-all blasting efficiency. Actual service life varies with the size of the nozzle, the type of abrasive used, and the air pressure employed. With pressures not exceeding 90 pounds, the manufacturer's standard guarantee is that the orifice of a "Norbide" nozzle will not be enlarged more than 50 percent after 750 hours' use with silica sand, or 1500 hours with steel grit or shot.

The capacity of a nozzle to retain its original orifice size and contour for so long has two favorable results. It greatly reduces the consumption of compressed air and makes for sustained blasting velocity and a concentrated stream of abrasive.









LONG "NORBIDE" NOZZLE SERVICE

The left-hand and central nozzles were in use for 2272 hours spraying steel grit and shot under 85 to 90 pounds air pressure. An unused nozzle is shown with them for comparison. High-speed photographs of pressure-blast nozzle streams (right) illustrate: top, stream from new iron nozzle; center, same nozzle stream after three hours' service (lower abrasive velocity and stream concentration); bottom, "Norbide" nozzle stream after 404 hours' service with silica sand.

English Tidal-Power Scheme Revived

GENERATION of power from tidal energy is again being proposed in England, where a revised scheme for constructing hydroelectric works in the estuary of the Severn River is under consideration. A technical committee of three experts was appointed in November, 1943, to review, in the light of late engineering experience and conditions, the plan rejected in 1933, and this body tendered its report on March 2. Revival of the Severn scheme calls up memories of the ill-fated Passamaquoddy Project that was started in Maine in 1935 but was never completed because Congress declined to make further funds available for the purpose.

Since early times, tidal flow has occasionally been harnessed to operate grist mills, but thus far no large-scale plant has been built. The location of the proposed Severn power works is near the confluence of that stream and the Wye, at a reef known as the "English Stones." The mean tidal range there is in excess of 28 feet, and the flow attains a maximum velocity of 8.75 knots. It is calculated that enough energy is available there for an electric plant having a greater output than any steam-generating station in England.

The great weakness of tidal-power projects is the intermittency of the water flow. In the 1933 Severn scheme (and also in the case of Passamaquoddy) it was proposed to pump water during the period of incoming tide into a reservoir at higher level and to release it so that power might be developed at slack tide. The recent report excludes this feature and covers only intermittent generation.

The 1933 project provided for a sluice dam with gates through which the water would flow during the rising tide. Then, when the gates were closed during ebb tide, the water would flow out through turbines located in another dam. This is termed single-tide working, whereas the Passamaquoddy plan of producing power on both the rising and falling tides is referred to as double-tide working. There were to be 72 water-wheel turbines, each connected to a 12,000-kw. generator. It was contemplated that 67 of these would be in service, leaving five as spares. On this basis the output, during operating periods, would be 804,000 kw.

The principal advances since 1933 that have had an effect on the scheme are the general use of larger turbines, an increase in the price of coal in England, and the development of a grid system in which the principal power stations of England are interconnected. The existence of this system would not only enable the tidal-power plant to feed its energy into the distribution network but, during its operating hours, would allow some of the steam-generating plants to be shut down. This would result in a saving of coal, which is seen to be the chief virtue of the Severn Project.

GENERAL PLAN

The initials F.P. indicate the points in the system where the proposed fish passageways are to be constructed.

The 1945 report favors power production during the ebb tide only, as was also proposed in 1933. It eliminates the storage-reservoir feature because it would increase the capital cost of the scheme by some 40 percent and, in operating the pumps, would consume about 27 percent of the power developed. It specifies a sluice dam with 128 gates and two turbine dams, one of which would also be fitted with sluice gates to permit the passage of water during the rising tide. Each turbine dam would have sixteen 25,000-kw. generating units, or a total of 32, of which two would be held as standbys. Two locks, each 750 feet long and 70 feet wide and providing for a maximum depth of 34 feet, would keep the river open for shipping, and there would also be included four or five passageways for fish.

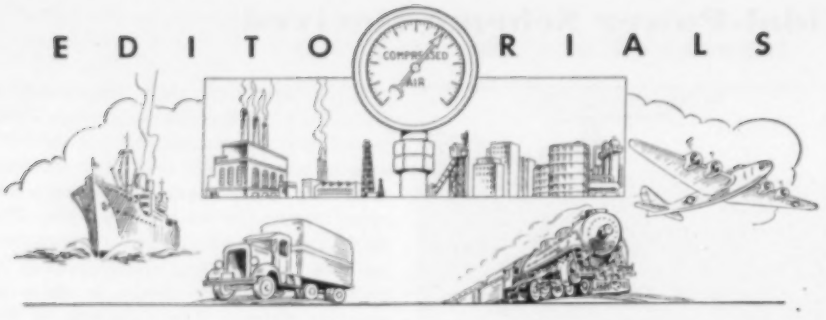
Operation of the 30 generators at the rated capacity would produce 750,000 kw. of energy, but as they would have an overload capacity during the short interval of maximum output at spring tides, it is expected that they could then be run to develop 800,000 kw. In every 24 hours there would be two periods of operation of approximately seven hours each. The plant would generate a total of 2365 million kilowatt-hours of power annually. Deducting unavoidable losses, the current delivered to the substations for transmission would be around 2190 million kilowatt-hours.

It is estimated that the complete works could be built in eight years. This is just half the time estimate of the 1933 scheme and reflects the great advance that has been made in construction speed during the intervening years. The project would give direct employment to 8000 persons and indirect work to 9500 others at the peaks in their respective fields. The hugeness of the undertaking may be judged somewhat from the following approximate quantities of some of the principal materials that would be required: cement, 565,000 tons; quarried stone, etc., 4,240,000 tons; shaped granite, 272,000 cubic feet; iron and steel, 160,600 tons; copper, 5000 tons. In addition, the appurtenant transmission lines would need 100,000 tons of steel and 6000 tons of alloy steel, copper, aluminum, etc.

The construction cost is estimated at 47,006,700 pounds sterling on the basis of present costs, and 28,640,000 pounds sterling on those for 1936, which are considered to be closer to the probable postwar figures. It is proposed to amortize the investment on the following time bases: permanent engineering works, 80 years; power-plant equipment, 35 years; transformers and switchgear, 20 years; transmission lines, 25 years. The annual operating costs, computed on 1944 figures and including outlays for dredging silt from the area above the dams, is placed at 450,000 pounds sterling. The addition of amortization charges would bring the total to 1,535,300 pounds sterling on the 1936 construction-cost basis and to 2,415,239 pounds sterling on the 1944 basis.

As previously indicated, the economic justification for the scheme is predicated chiefly upon the resultant saving in coal. This is a vital consideration, since it is estimated that Britain's coal reserves will be exhausted in about 40 years. Because the intermittent output of tidal power would seldom coincide with the peak demand upon the grid system, none of the existing coal-fired generating stations could be eliminated; but, as has already been pointed out, some of them could be shut down during the periods when tidal power is available. The saving in coal is computed at 1.046 pounds per kilowatt generated, or a total of 985,000 tons annually. To break even financially, coal would have to be selling at about 15 percent more than the current price. However, the committee predicts that that will be the prevailing rate in 1955, which is probably the earliest date the tidal scheme could be put in operation. At the same time, it has to be assumed that the rising price of coal will be instrumental in bringing about more efficient steam-generating plants.

EDITORIALS



PEPPING UP OUR RICE

ORIENTALS eat their rice unhusked and consequently get the full benefit of its Vitamin B content. Being fussy about appearance, we insist that our rice be polished. That makes it look better, but deprives us of some of its nutriment. Now we have found a way by which the Vitamin B can be transferred from the husk to the grain. It seems a little silly to go to this trouble rather than to eat the husk, but we are that kind of a people.

The new process is called converting, and plants for doing the work are already operating in Texas, with most of their output going to the armed services. The basic principle of the method is the same as that of wood impregnation. The rice, with the husks on, is placed in a sealed vessel from which most of the air is evacuated. Then water is introduced and the vacuum broken. The water dissolves the vitamin in the husks, and the increase in pressure in the chamber forces it into the grains, which may then be polished until they are pearly white.

Converted rice is reported to keep well and cook well and to resist weevils. There would seem to be no reason why the same process could not be applied to wheat, corn, and other cereals so as to enrich them with any vitamins that we may want to put in them.

GOLD-MINING REVIVAL

ALL indications point to unprecedented gold-mining activity in the postwar years. Despite a lot of talk to the contrary, the world has clearly indicated that gold is still the most desired commodity in existence. At the Bretton Woods conference last July, 44 nations definitely favored gold as the basis for stabilizing currency and settling international debts. Since then the Axis powers, which were the chief advocates of managed currencies, have lost their voice in global affairs. Meanwhile, in the free markets of the world, the price of gold has soared far above the fixed rate of $35 an ounce that prevails in the United States and that has recently been adopted also by Great Britain.

Only two nations, the United States and Canada, officially curtailed gold production during the war period. In our own country the shutdown was complete; but in Canada, established mines were permitted to continue operating as best they could, while newly launched ventures and prospects were prohibited from sinking shafts or doing any other underground development work. Nevertheless, shortages of manpower and machinery greatly reduced output and, in some sections, notably British Columbia, forced many mines to close. Even in South Africa, the leading gold-producing nation, economic conditions and high taxation combined to put some properties out of business and to cut profits of others. All activity in the Philippines and New Guinea was stopped by the Japanese invasion. Reports from Russia are meager, but with the Soviets concentrating on war goods, it is unlikely that her gold mines were operating normally.

Canada and the United States have now removed the legal restrictions on gold mining and thus prepared the way for the resumption of full-scale activity. The economic barriers—shortages of labor and equipment—still exist, and many months may pass before adequate supplies are available. The best the industry can hope for in the United States is that former producers will restore operations and perhaps equal their all-time high output of 1940. No new fields have been discovered since the shutdown became effective and there is little reason to believe that any important finds are to come. In Canada, however, the situation is different. The Dominion is expecting the greatest gold-mining boom the world has seen because feverish prospecting has been carried on there during the war period and numerous new mines are undoubtedly in the making.

In the older mining areas of Ontario and Quebec some startling discoveries have been made close to present producers, while other promising prospects have been uncovered in more remote sections, thanks largely to airplane transportation. At Yellowknife in the Northwest Territory, where two or three rich but small mines have previously been operated, a large gold field seems to be awaiting development. The Snow Lake district in Manitoba also appears to be facing a bright future.

With shaft sinking banned, underground probing has been done with diamond drills. On a single property in the Yellowknife area more than 10 miles of holes have been drilled, and the total for all prospects runs into the hundreds of miles. This form of exploration gives definite evidence of mineralization and largely removes the gamble from subsequent expensive underground development work. More than 50 companies are ready to sink shafts as soon as they can obtain the required equipment.

In addition to the discovery of new mines, several of the established operators have had encouraging results from deep prospecting, which has given ample evidence that the gold veins persist well below the existing lowest workings. The Lake Shore Mine in the Kirkland Lake area has ore on its 6800-foot level and is preparing to sink to the 8000-foot horizon, while both the Wright-Hargreaves and Sylvanite have found ore in diamond-drill holes more than 7000 feet below the surface.

FEWER UNEMPLOYABLES

EXPERIENCES during the war in finding jobs that the physically handicapped can perform satisfactorily offer hope for the future of disabled war veterans. The employment service of the War Manpower Commission has been so successful in placing such persons in industry that it is now doubtful whether many of them can rightfully be classed as "unemployable."

During the depression period, when even the physically fit had hard sledding, there were between 2,500,000 and 3,000,000 handicapped men and women in the country who had virtually no chance of getting or holding jobs. Under the stress of wartime labor shortages, these people began to seek and obtain work. Records of the Government employment offices indicate that of this vast number about a million are now listed as employable just as they are, while more than another million will be employable after some measure of rehabilitation.

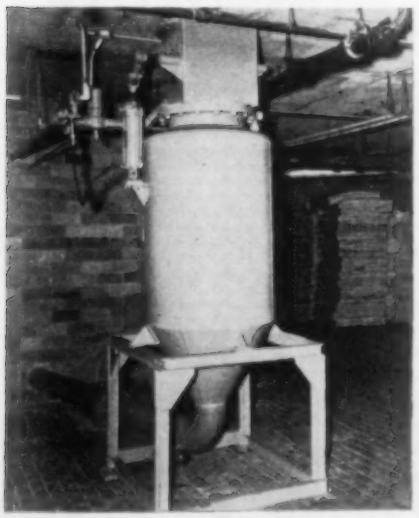
The interesting part of it is that physical handicap is sometimes an asset rather than a detriment. For example, blind workers have an extraordinary sense of touch that qualifies them for sorting mica, while deaf persons make good riveters because the noise doesn't bother them. Even those without arms or legs are doing jobs for which they would never have been considered in normal times. A shining current example of this is the case of Pete Gray, one-armed baseball player on the St. Louis American League team. There was no sentiment attached to his employment. He made a place for himself in the "big time" by proving his ability in the minor leagues. Admitting that this is exceptional, it still will inspire many returned service men who are disabled to "stay in there and pitch," to use an expression from the baseball diamond.

Pneumatic Ejector and Transporter

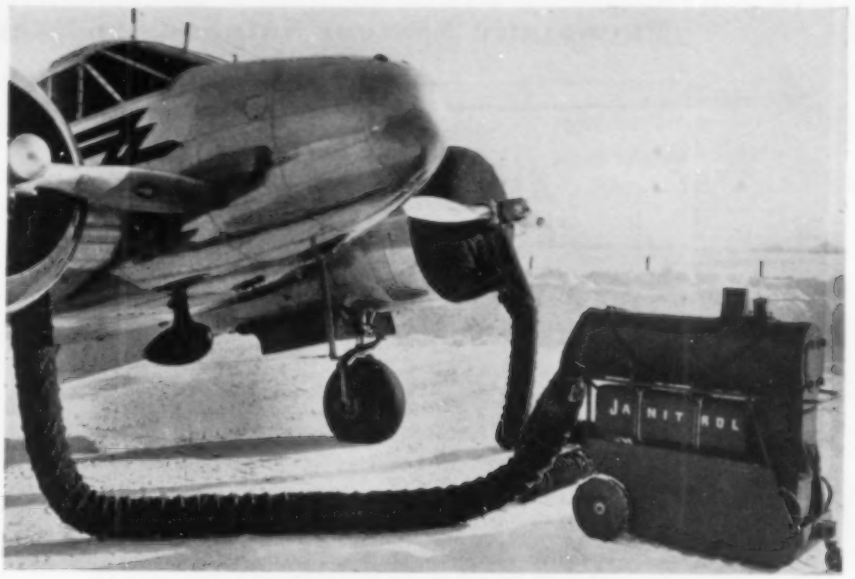
FOR pneumatic evacuation, where bulk materials must be moved considerable distances, the Transporter type of Yeomans Brothers Company will serve without the use of mechanical devices or trucks. In this unit the discharge line is the means of conveyance and compressed air is the propulsive medium. It is designed to handle most industrial wastes, pulp and paper products, sewage sludge, ashes, powdered coal, etc., that will flow through pipe lines but that are too bulky for transfer by pumps.

Operation of the equipment is fully automatic. The material is fed into a conical hopper until it reaches a predetermined level. Then the inlet valve is closed and held shut by an air cylinder. This causes another valve to open and to admit compressed air into the receiver. Pressure is thus exerted against the free surface of the contained fluid, forcing it down and out. Once this action is started, the air supply is discontinued and the air is used expansively to empty the hopper and to scavenge the discharge line. When the latter is blown clear, the pressure drops to that of the atmosphere, the inlet flap valve opens, and another cycle begins.

Just what the operation involves is exemplified in the case of the South St. Paul sewage-treatment plant where a Transporter transfers sewage and packing-house wastes by way of a surface tower to lagoons where they are left to dry for disposal by burning, an indication of the density of the material handled. The unit ejects 200 cubic feet of waste with each discharge and has seen many months of service. The air requirements differ with the size of the equipment, which has a displacement range of from 10 to more than 200 cubic feet.



TRANSPORTER-TYPE EJECTOR



TOLEDO AIRPORT BORROWS IDEA FROM ALASKA

Temperatures dropped so low at Toledo, Ohio, last winter that the local airport preheated airplanes with portable equipment developed by Surface Combustion for service in Alaska. The unit burns gasoline, kerosene, or fuel oil and is used by the Army to preheat engines, cabins, instruments, and windshields of planes in very cold climates. Other military applications are the heating of hospital and headquarters tents and barracks. In hot, humid places the portable equipment furnishes heat for drying out workshops and preventing the corrosion of plane instruments by moisture.

Soil-Cement in Highway-Improvement Work

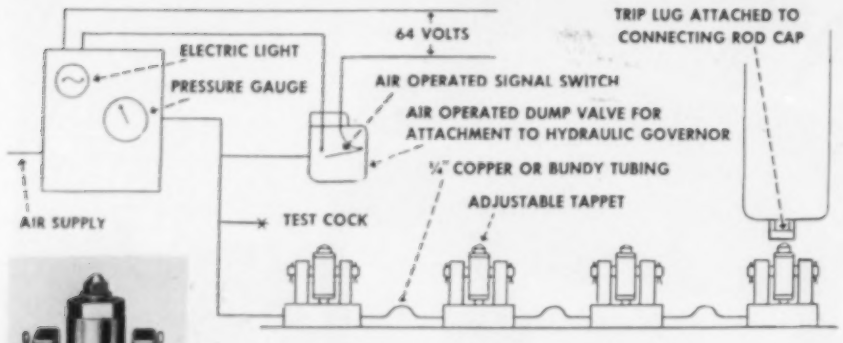
SOIL-CEMENT, which was fully described in our November, 1943, issue, is being used to good effect by the Georgia State Highway Department to repair and widen a heavily traveled 18-foot highway. The test stretch is more than 22 miles long and is apparently so satisfactory from the standpoints of speed of operations, cost, and results that contracts for the improvement of 30 additional miles have been awarded.

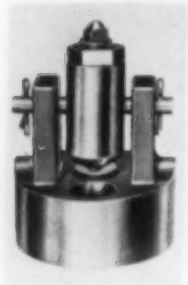
The section that has been modernized was laid in 1920 and consisted partly of reinforced and partly of unreinforced concrete. The latter, largely because of the instability of the foundation, had become badly cracked and disintegrated. These areas have been repaired by breaking up the concrete with air-operated paving breakers, removing the subsoil to a depth of 6 inches, filling in the excavation with soil-cement, and compacting it with pneumatic tampers. The material was made up of top soil containing about 15 percent by weight of silt and clay, of 10 percent by volume of ordinary portland cement, of 30-40 percent by weight of crushed granite chips or slag not exceeding 1½ inches in size, and of enough water to bring the moisture content up to about 12 percent. The mix was spread in layers 4 inches thick and was successively tamped until it was level with the surface of the old concrete.

To give the road a width of 23 feet, a 2½-foot trench was dug along each edge by a trenching machine and filled with soil-cement to a depth of 11½ inches. This was consolidated to a thickness of 8 inches by a tractor with a big sheep's-foot roller substituting for one rear wheel. Pneumatic-tired rollers finished the job. No forms were used in this work; the material was dumped into the excavation and spread by a special box pulled by a crawler tractor. Both the patches and the side strips were cured by covering them with 3 inches of earth that was periodically sprinkled with water for about a week.

There were no expansion joints in the old highway, so 2-inch-wide slots were cut in it on 180-foot centers by paving breakers and filled to within 1 inch of the top with a mixture of sawdust and asphalt. The remaining space was filled with modified Topeka asphaltic concrete. Both the old and the new construction, including joints, were then surfaced simultaneously. First was applied a tack coat, followed by a 1-inch asphaltic-concrete leveling course, a tack coat, a 1½-inch binder course of asphaltic concrete, and a ¾-inch wearing surface of Topeka asphaltic concrete. Like in the case of the patching operations, only one lane was closed at a time during paving so as not to interrupt the movement of traffic. The total cost of the improvements, including drainage, grading, and other work incident to widening, is approximately $19,000 per mile.

Pneumatic System Safeguards Engine Crankshaft





CRANKSHAFT PROTECTORS

General layout of the system that automatically shuts down a diesel engine as soon as a connecting-rod or main bearing is worn beyond a predetermined point. A number of "Watchdogs" are used for the purpose. One of them is shown at the left. It is really a trip lever that becomes operative when it is struck, following excessive bearing wear, by the lug on the connecting-rod cap.

"WATCHDOGS" that stand guard over diesel engines and automatically shut them down as soon as the crankshaft is endangered by a worn connecting-rod or main bearing are claimed to pay large dividends by preventing costly replacements and repairs. The new device is a development of the Paxton Diesel Engineering Company and is known as the Bearing Watchdog System. It consists essentially of a trip lever that is installed in the crankcase under each connecting-rod throw, of a lug for each connecting-rod bearing cap, of a dump valve to be attached to the servomotor of any standard hydraulic governor, and of a control box containing an air-pressure reducing valve and a tell-tale light. Under normal conditions, air at a constant pressure of 10 pounds is maintained in the protective system.

Between the trip lever and the lug on the connecting-rod bearing cap there is a clearance usually of about 0.012 inch, which represents the maximum amount of wear permissible. In the event the bearing wears excessively or shells out, the lug strikes the trip lever, thus releasing the air in the system and actuating the dump valve on the governor, which at once shuts down the engine and lights the signal lamp. The engine is similarly stopped when a main bearing goes out, because the crankshaft will flex sufficiently to trip the lever. The Watchdog also protects the engine in case of broken bearing caps, cap bolts, or connecting rods because release of the air pressure through any cause will set in motion the chain of operations that results in shutdown. The company reports that the system has been thoroughly tested and proved on leading railroads.

Robert Fulton's Submarine

THE steamship was born because Robert Fulton was disappointed in being a success—a success as a submarine designer. Fulton built his *Nautilus* in Paris around 1800. The craft was a mixture of the modern and the past, for while many up-to-date ideas were used she carried a sail for surface motive power. The sail could be taken down and stowed, and the vessel could be submerged in two minutes.

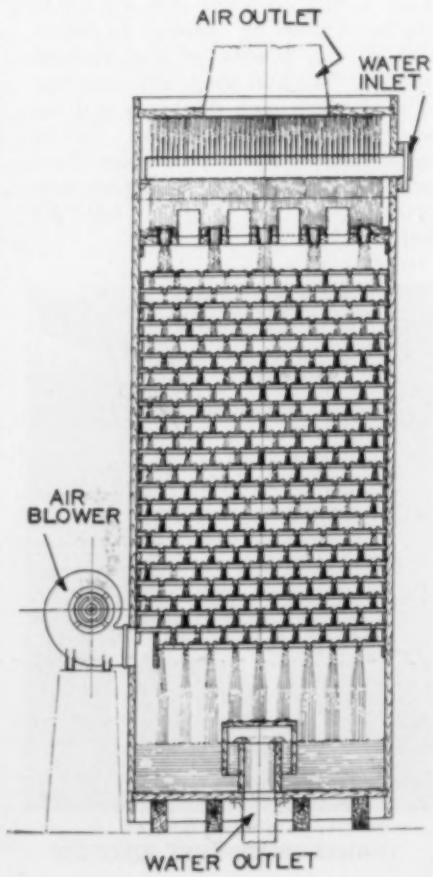
The submarine had a diameter of 6 feet and somewhat resembled the undersea boats of today. Fulton not only used tanks of water and horizontal planes to enable the craft to rise and sink at will, but he also knew the value of compressed air. This air was stored in reservoirs, and because of it the occupants of the *Nautilus* could remain below the surface for a long time.

Fulton's boat also carried a torpedo and mine equipment, and though tests proved the *Nautilus* highly successful, the U. S. Government showed so little interest that Fulton forgot about traveling underwater and turned his attention to on-the-surface transportation.

Boiler-Feed-Water Decarbonator

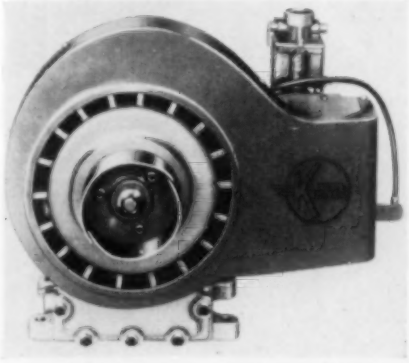
THE removal of gases from boiler feed water is ordinarily accomplished during the process of heating, but in the case of water containing relatively large amounts of corrosive gases such as carbon dioxide or hydrogen sulphide it is desirable to extract them while the water is cold and without regard to other soluble gases such as oxygen. Their elimination prior to heating the water protects pipe lines, heaters, and other equipment from corrosion, and it also reduces the load on deaerating apparatus used subsequently. The accompanying drawing shows a cross section through a Cochrane Decarbonator. As its name implies, the unit is designed primarily for the removal of carbon dioxide, but it also serves to eliminate hydrogen sulphide, sulphur dioxide, methane, and other gases.

The water is sprayed into the equipment at the top, and the resultant separation of the stream into fine subdivisions liberates some of the gases and consequently reduces the load on the unit. The sprayed water flows through ferrules that distribute it evenly over the uppermost member of a series of staggered trays down which it cascades. To remove the separated gases and to reduce their concentration in the atmosphere in contact with the water, air at low pressure (around 2 ounces) is introduced into the bottom of the decarbonator and flows countercurrentwise to the descending water. During its rise, it picks up the gases and is exhausted at the top. The decarbonator is constructed mainly of cypress or redwood. Such metal parts as are needed are suitably corrosion-resistant. The height of the tray stack and the volume of air required are determined by the nature of the gas, its initial concentration, the temperature of the water, and the residual content desired.



Industrial Notes

A 5-hp., all-purpose engine embodying principles that are said to be new in the design and manufacture of small engines has been announced by Kinner Motors, Inc. Called the Busy Bee, the Model AB-3 is an air-cooled, 4-cycle, L-head unit that is rated at 5 hp. at 2600 rpm. but develops 6 hp. at 3250 rpm. The single cylinder is horizontal and detachable, making for ease of maintenance. The engine has a 2¾-inch bore, a 3-inch stroke, and a displacement of 17.8 cubic inches. It takes up only 2.4 cubic feet of space and is claimed to be the lightest on the market in its horsepower class—crankcase, piston, head, and other parts being of aluminum alloy. Because of its compactness and light weight, the unit is especially well adapted for the driving of portable equipment. Torque curve on the engine is practically flat, which demonstrates its capacity to "lug" under heaviest load conditions. Full pressure lubrication is provided by a positive high-pressure pump. An illustrated bulletin giving detailed engineering data may be obtained by addressing the company at Glendale 4, Calif.



Greene, Tweed & Company has announced a new rod packing made of asbestos yarn the fibers of which are impregnated with a special grease lubricant. The packing is plaited in square form, ranging from ¼ to 1 inch in section and from 21 to 1½ feet in length per pound, respectively. It is known as Palmetto Plaited and is suitable for hot- and cold-water service in hydrants, valves, pumps, etc.

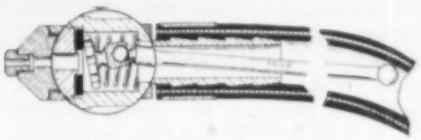
To seal aluminum and magnesium castings against liquid or vapor leakage, Monsanto Chemical Company has produced a series of thermosetting plastics designated as Thalid X100. The materials are based on varying mixtures of resin and styrene monomer and differ in viscosity to meet given requirements. Application is by vacuum-and-pressure impregnation, after which the castings are cured by heat until the resin in the pores is of a rubbery consistency. The sealing compound is said to be resistant to lubricating oils, hydraulic fluids, cooling solutions, and temperatures such as are encountered in engine operation.

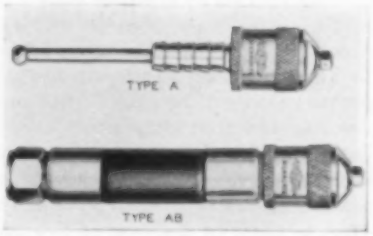
Strip magnesium in coils is being offered by the Burgess Battery Company which initially produced the material for its own use. It is named Thinstrip and is available in ¾- to 5-inch widths and 0.1 to 0.005-inch gauge.

Theft or adulteration of coal, crushed rock, or similar materials can be guarded against by spraying them with a chemical that fluoresces when exposed to ultraviolet light, thus permitting detection. In daylight the products appear normal.

It is reported that high-pressure air delivered in whirling jets is being used instead of conventional rubber-edged wipers to keep airplane windshields free of water and ice. For the latter purpose a small quantity of alcohol or antifreeze is injected into the air stream.

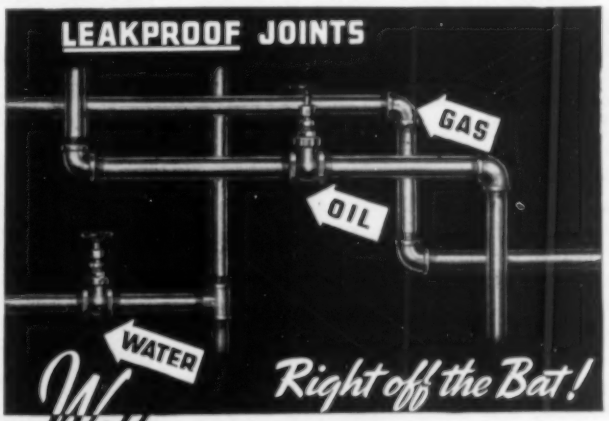
A patented ball-and-socket valve joint is the principal feature of a new line of leakproof air guns being made by Trico Fuse Mfg. Co., for blowing away dust, dirt, and chips; for kicking out finished parts; and for operating pneumatic equipment such as vises, clamps, chucks, and presses. The joint eliminates the use of levers, buttons, gaskets, or glands and has only two moving parts. These are controlled manually or by mechanical means, depending upon the type. Of the two shown in the accompanying illustration, "A" is attached permanently to an air hose and is operated by fingertip, while "AB" is fastened directly to the air-supply pipe and is designed for hand or remote control. It consists of a Type "A" gun and of a short length of hose assembled with standard female pipe fittings and is variously mounted for operation by hand, treadle, pulley, cam, plunger, etc. Slight flexing of the hose by





any of these means in either case discharges a puff or a strong blast of compressed air from the gun, the volume being regulated by a suitable stop. When restored to normal position, the valve joint is sealed by the air pressure in the line. Three styles of guns are available for the full range of hose diameters.

Asbeston is the trade name of a new woven-asbestos fabric that is obtainable in varying weaves and weights for different purposes. There is a thin open weave weighing 8 ounces per square yard that is used with synthetic coatings as an insulating material for cables. Another of close weave weighing 16



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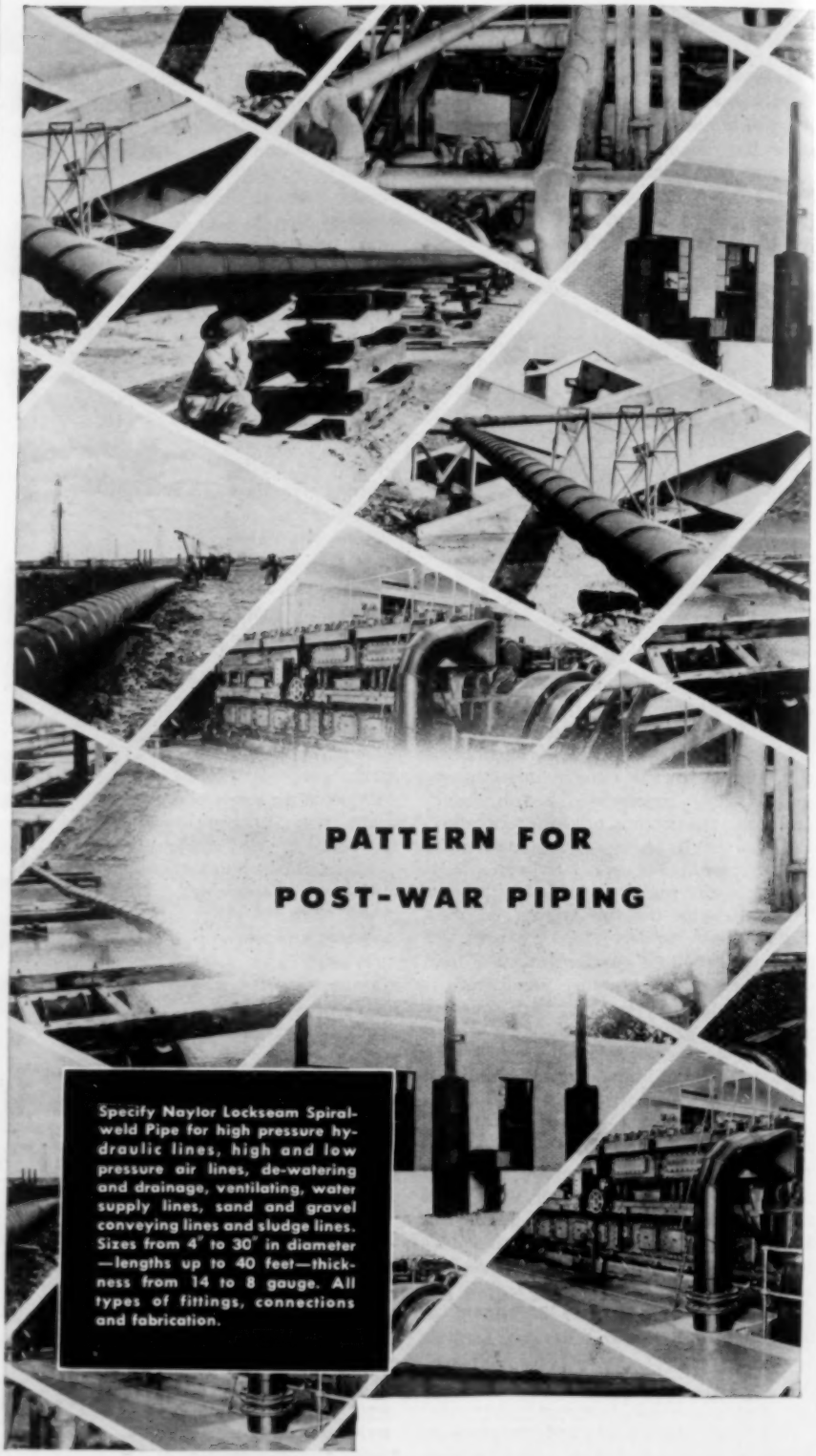
ounces is suitable for making lightweight air ducts. The heaviest weighs 20 ounces and enters into the manufacture of laminated plastic products, protective clothing, and curtains. The cloth is a product of Burcott Mills, which is prepared to supply it or to make it up into fire blankets, tarpaulins, and other articles to specifications.

According to *Foreign Commerce Weekly*, a Swiss firm has developed a small apparatus that can be attached to any typewriter and that eliminates the use of carbon paper. It is a product of the watch industry. Basically, sheets of paper are interleaved with typewriter ribbons so that, in the case of five impressions, three will be originals and two copies imprinted on the backs of thin, transparent sheets.

Incandescent bulbs that have less power to lure night-flying insects than the conventional type would seem to discount the familiar story about the moth and the flame; but a recent news release from the Solar Electric Corporation tells us that it is putting such lamps on the market. The new bulbs are coated on the inside with a ceramic that transmits only the yellow part of the spectrum—in other words, combs out those with wave lengths that attract phototropic insects from greater distances.

Samples of a mold coating for use in pouring steel, iron, and nonferrous castings are being offered foundrymen by the Hercules Powder Company, Wilmington, Del. The fluid—named Truline Mold Spray 91—is made of a special resin and quick-burning solvent and is ignited as soon as applied, leaving a thin film of resin that strengthens, hardens, and dries the surfaces. It is claimed that molds so treated can be used immediately and prevent sand from falling away when cores are set and molds are closed.

Carbon removal from aircraft, automotive, and diesel-engine pistons and other parts can be expedited, says Turco Products, Inc., by supplementing the usual chemical process with its Carboblast treatment. The latter involves the use of regular cabinet-type blasting equipment and ligno-cellulose pellets which, being smooth and nonabrasive, are applied without the necessity of masking bearings and bushings, or plugging spark-plug holes. The material knocks off residual carbon, oxides, and gums without scratching or marring mirrorlike surfaces and comes in varying sizes so as to penetrate and clean narrow recesses such as piston-ring lands, cylinder fins, screw threads, etc. It is claimed that the time normally required to soak off deposits is materially reduced as a result of this pretreatment.


PATTERN FOR
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Specify Naylor Lockseam Spiralweld Pipe for high pressure hydraulic lines, high and low pressure air lines, de-watering and drainage, ventilating, water supply lines, sand and gravel conveying lines and sludge lines. Sizes from 4" to 30" in diameter—lengths up to 40 feet—thickness from 14 to 8 gauge. All types of fittings, connections and fabrication.
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Any compressor drive is more efficient with automatic tension control.

Regardless of type of belt, any short-center drive should have a means of controlling tension automatically. With proper tension maintained at all times by means of pivoted motor base, more air will be supplied. Belt life will be lengthened . . . less strain on bearings . . . lower maintenance cost. *But*, automatic tension control is not the whole answer. Consider this:

And any compressor is more efficient with a **VIM TRED BELT !**

Leather belts are admittedly the toughest for severe compressor service. VIM Leather, made in Houghton's tannery by our exclusive mineral tannage process, is given a further treatment in the form of *treading*, which "gears" the belt to the pulley, restricts slipping, provides greater pulling power. Put a VIM Tred Leather belt on your compressor, hold it under proper tension at all times, and you have the best in power transmission. E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pennsylvania.

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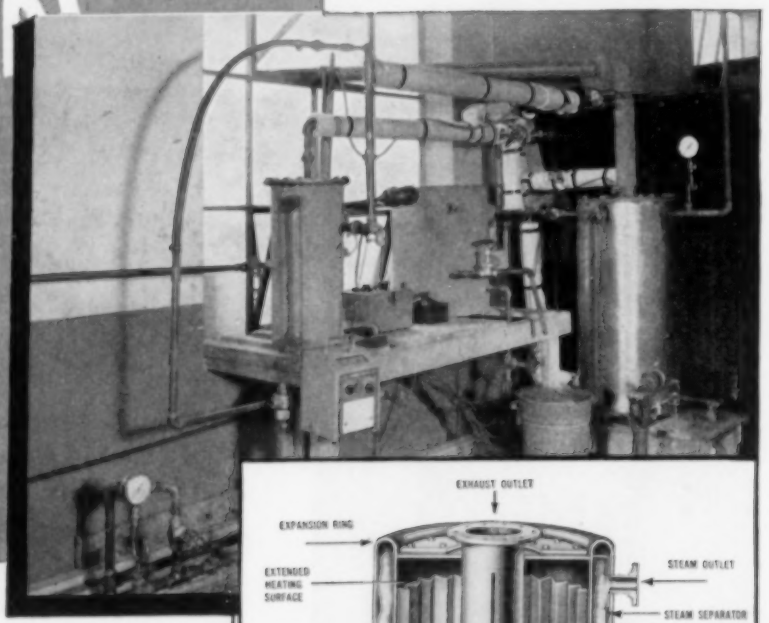
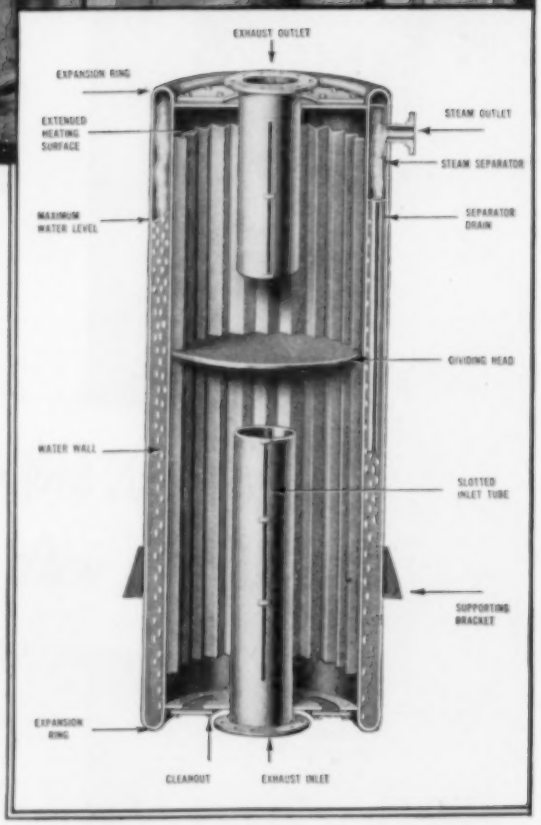
WITH MAXIM HEAT RECOVERY SILENCERS





The illustration above shows a test hook-up for Heat Recovery Silencer research in the Maxim Research Department. Here again, as in Maxim Silencers, the basis for superior performance is constant and painstaking research which results in proper basic design and a never ending search for improvement.

Maxim Heat Recovery Silencers provide effective silencing of exhaust noise, 100% spark arresting (where this is desired) and the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations.

These Heat Recovery Silencers are available with automatic controls which control steaming rate by varying water level in the water wall of the Silencer. They may be run wet or dry. Highly efficient heat transfer is assured by the Maxim extended heating surface feature.

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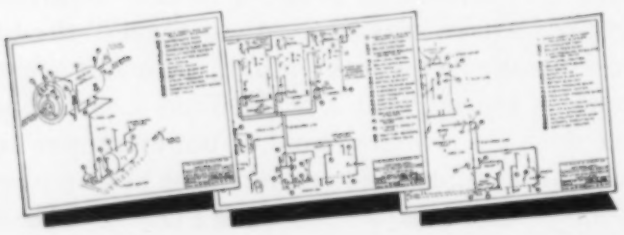
For silencing without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



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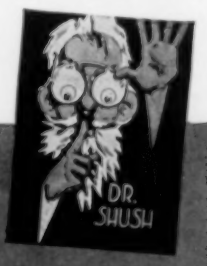
Typical Heat Recovery Silencer hook-ups are available with a detailed discussion of each. We will be glad to send them to you. Just ask for Dwgs. B-298, B-301, B-302 and B-303.

THE MAXIM SILENCER CO. • 85 HOMESTEAD AVE., HARTFORD, CONN.



ARMY E NAVY

MAXIM

How Allis-Chalmers Engineering Discovers New Ways to Build Better Motors for You.

WANTED: D-C Motors to Dive for Navy!

BUILD SUBMERSIBLE MOTORS to run 25 feet under water — and build 'em to run that way 90 days at a stretch! That's the tough assignment Navy engineers turned over to Allis-Chalmers.

Those motors had to: 1) withstand sea pressure; 2) stay waterproof; 3) be light in weight.

No. 1 problem was . . . *how to build water-tight casings.* A-C engineers experimented, found the solution in fabricated steel.

Quickly, individual casing parts were built. Subsequent hydrostatic tests applied to them showed molecular arrangement and carbon content of steel to be ok. Result —only a heavy weld between fabricated parts was needed to assure water-tightness!

Now the going was easier. For adequate surface seal, field yokes of one-inch rolled steel were used. End housings were reinforced. Exposed adjustments were made leakproof. Then . . . minor changes in insulation, at other points, and the problem was solved.

* * *

"What's all this got to do with *my* problems?" you may ask. Just this . . . Everytime A-C tackles the job of building special motors for extra-tough war applications, like this one, it also discovers important new ways to build better *standard* motors for you!

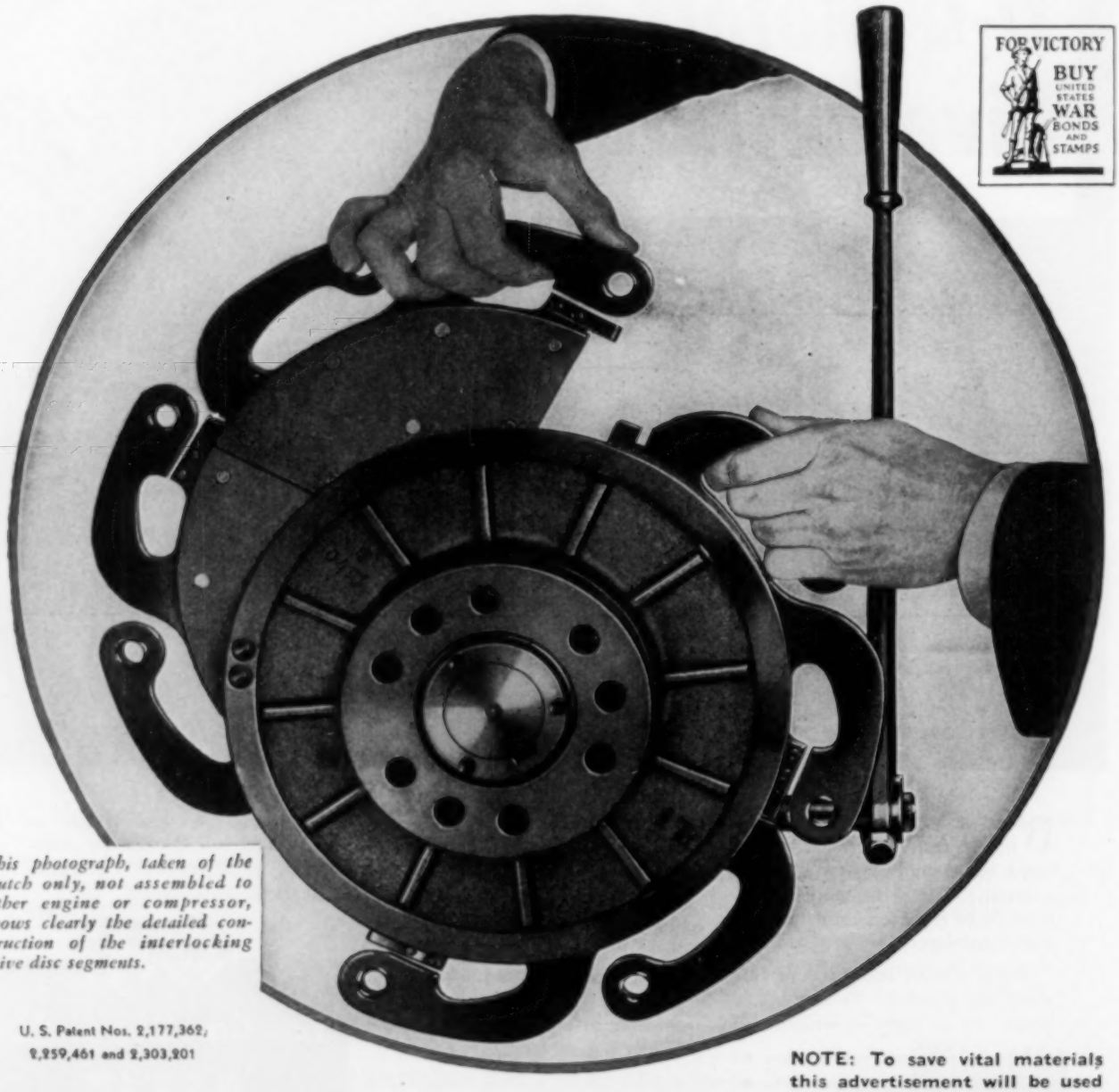
That's why you hear it said so often, *"You can depend on Allis-Chalmers Motors!"* ALLIS-CHALMERS, MILWAUKEE, WIS.

A 1889

You Can Depend on ALLIS-CHALMERS Motors

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

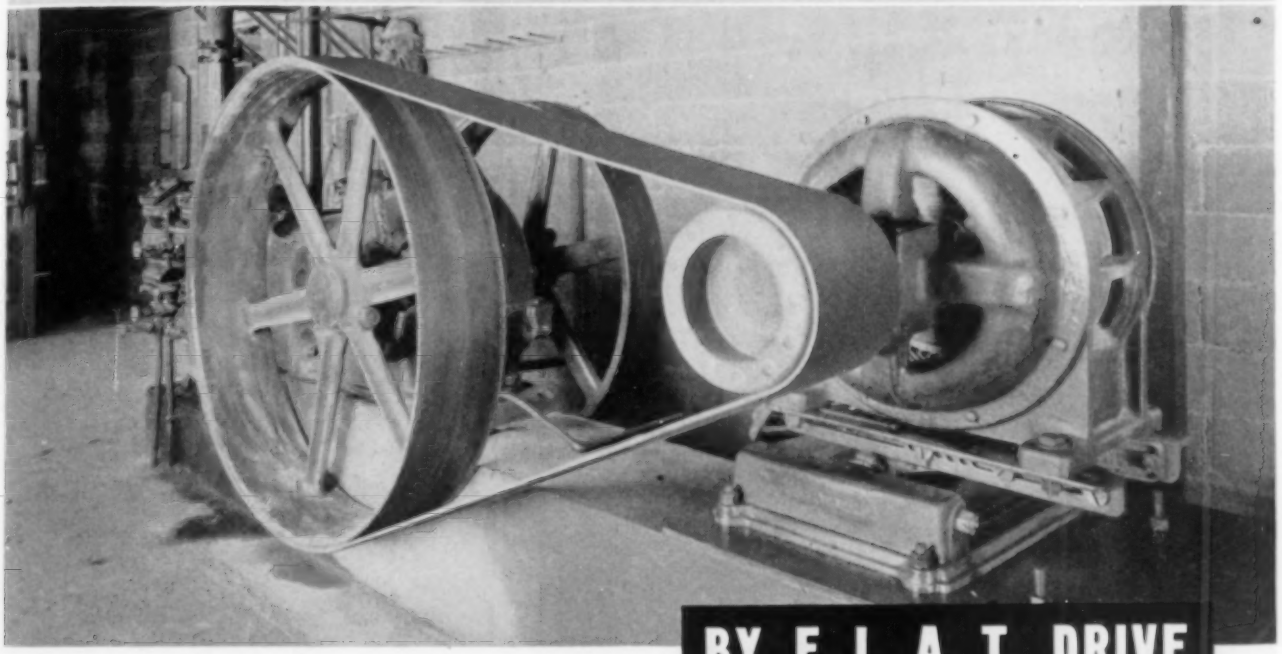
U. S. Patent Nos. 2,177,362, 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

SHOCK and PULSATING LOADS handled



BY F. L. A. T. DRIVE

For compressor drives characterized by shock or pulsating loads we recommend the Flat Leather Automatic Tension (pivoted base) Drive using Graton & Knight Research Leather Belt.

AUTOMATIC TENSION

There is no need for constant over-tension to handle shock or pulsating loads. Tension is controlled automatically. The pivoted base gives belts, shafts and bearings of driving and driven equipment opportunity to relax between peaks. Longer life and less maintenance are assured. Overheating of motors is eliminated.

CASE HISTORY

In the drive illustrated above, this Ingersoll-Rand Compressor was driven by a flat rubber belt idler drive on fixed centers. Re-engineering resulted as follows: pivoted base, #12 Rockwood; motor, 60 HP, 1200 RPM; motor pulley, 13" diameter; compressor pulley, 58" diameter; centers, 66"; belt, 10" heavy double Research. Operation of this drive is now entirely satisfactory even though pulley ratios are 4.4 to 1 and the center distance is little more than the diameter of the larger pulley.

BELT REQUIREMENTS

To meet the exacting requirements of this F.L.A.T. drive a leather belt must have these characteristics.

- High co-efficient of friction and maximum flexibility to utilize the small arc of contact on the driving pulley when short centers are used — Research belting is specially treated for maximum pulley grip and flexibility.
- Elasticity to absorb shock and pulsating loads — Research leather is prestretched scientifically according to the characteristics of the hide. Non-elastic stretch is removed without taking out the natural resiliency of leather.
- High tensile strength for long life and minimum maintenance — All Graton & Knight manufacturing processes contribute to the high tensile strength of Research belts. Careful hide selection, tanning, lubrication of fibres and stretching produce a belt that assures the owner of lower maintenance costs and longer belt life.

FREE MANUAL Write Graton & Knight Co., 365 Franklin St., Worcester 4, Mass., for new 56 page Leather Belting and Application Manual.

GRATON AND KNIGHT

Research Leather Belting

The most complete line . . . manufactured under one control from green hide to finished product. Graton & Knight distributors are listed under "Graton & Knight" in "Belting" section of Classified Telephone Directory and THOMAS' REGISTER.

DESIGNING PACKINGS ISN'T A JOB JUST ANYBODY CAN DO

THE DESIGN of packings for engines and compressors that cost important money isn't rule-of-thumb work. That's why France packings are fully engineered before they hit the shop floor. We do this to determine tolerances, to check the strength of the case, to determine the kinds of material needed, and to iron out other problems *before* manufacture.

Helium and hydrogen, for instance, being thinner gases, require more rings. Then there are such questions to decide as whether or not oil or condensate wiper rings are necessary . . . where to place oil holes . . . where to locate vents for returning gas to suction line. Special problems come up in materials for packings . . . involving the use of heat treated steel, stainless steel or bronze for corrosion resistance, or heat conductivity.

Remember these points when you specify or buy packing.

Some compressors are equipped with soft packing. To reduce power consumption, eliminate rod wear, and insure a positive seal for an indefinitely long period, ***specify France Metallic Packing*** when the compressor is ordered from the Engine Builder.

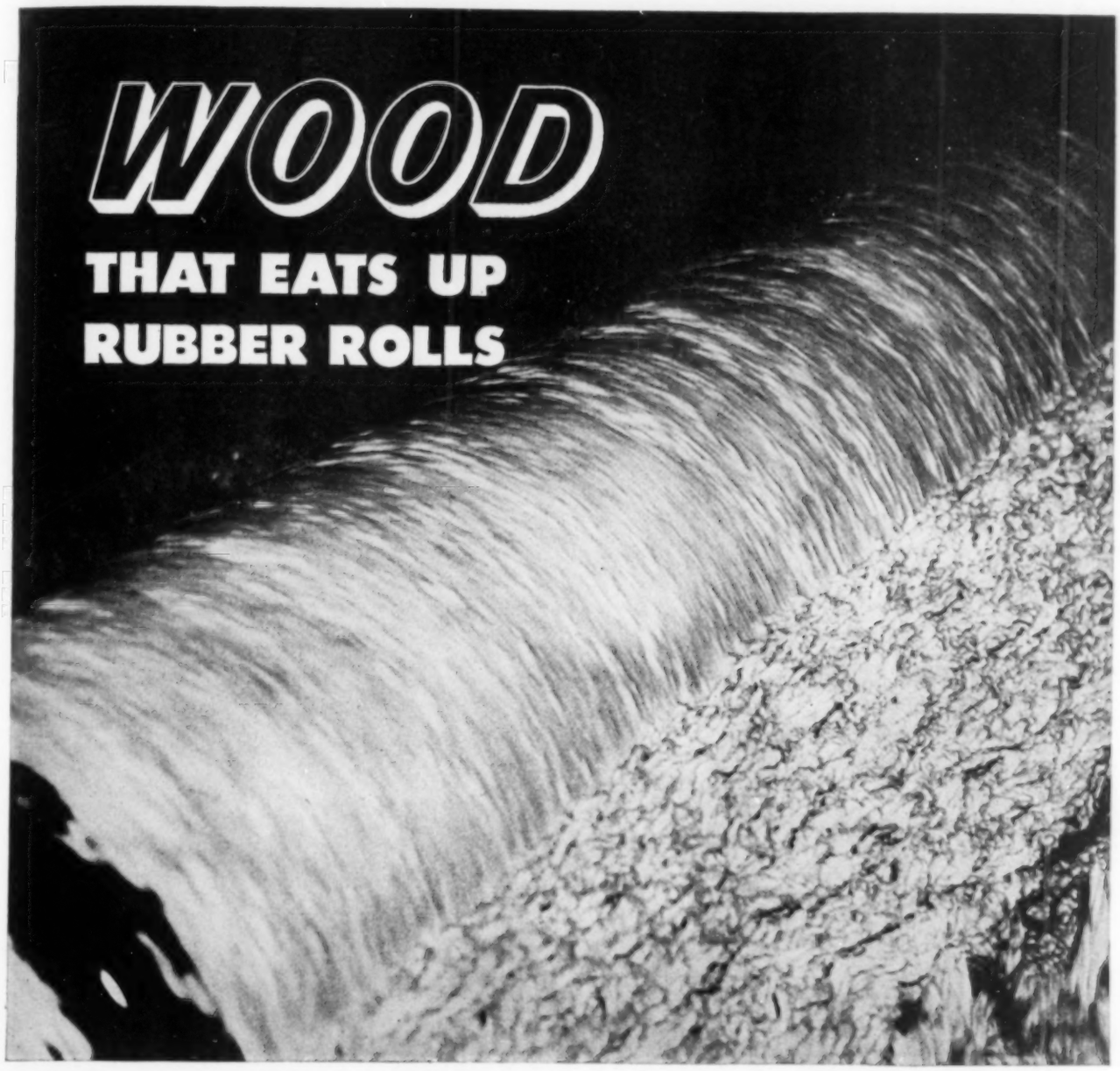
★ FRANCE PACKINGS and PISTON RINGS ★

FRANCE MFG. CO.

FRANCE MANUFACTURING COMPANY

E. A. France, President

Belgrade and Orthodox Streets, Philadelphia 37, Pa.



In a new paper mill, it was found that one type of roll was literally being "eaten up" by certain materials inherent in the ground wood stock.

After several such rolls made of natural rubber compounds had disintegrated, U. S. Rubber Engineers were asked for suggestions. A roll fabricated of a special synthetic rubber compound was recommended.

This has proved entirely "indigestible" to the wood stock . . . has already delivered many more months of service than the rolls tried previously . . . is setting up a record for steady, trouble-free service.

Our Engineers have been finding the answers to industrial rubber problems like this for many years...developing special compounds that overcome unusual conditions. When you encounter such a problem, let us help you solve it!

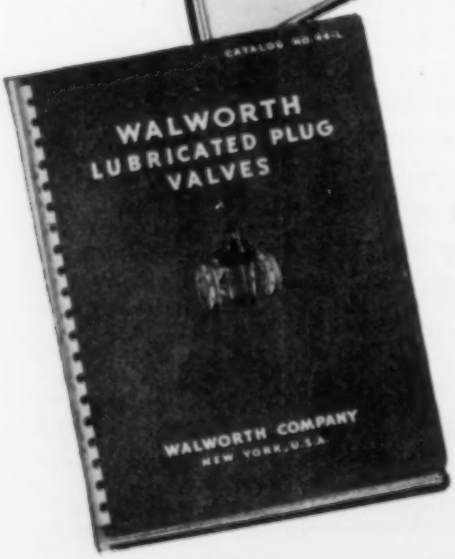
SERVING THROUGH SCIENCE
WITH ENGINEERED RUBBER

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon 3:00 to 4:30 E.W.T.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

YOUR NEW
Walworth Lubricated Plug Valve Catalog
IS NOW READY!



Write for your copy today
on your Company letterhead

Between the covers of this 94-page book you will find ways that Walworth can help you with your problem of handling petroleum products . . . acids . . . condensates . . . mud . . . organic solvents . . . slimes . . . slurries . . . and many other "difficult" liquids where conventional types of valves do not give satisfactory service. It is to your advantage to have this informative, important data.

A request on your company's letterhead, will bring you a copy of Catalog 44L. Write now!

14 AWARDS
TO 4 PLANTS

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valves and fittings
60 EAST 42nd ST., NEW YORK 17, N. Y.

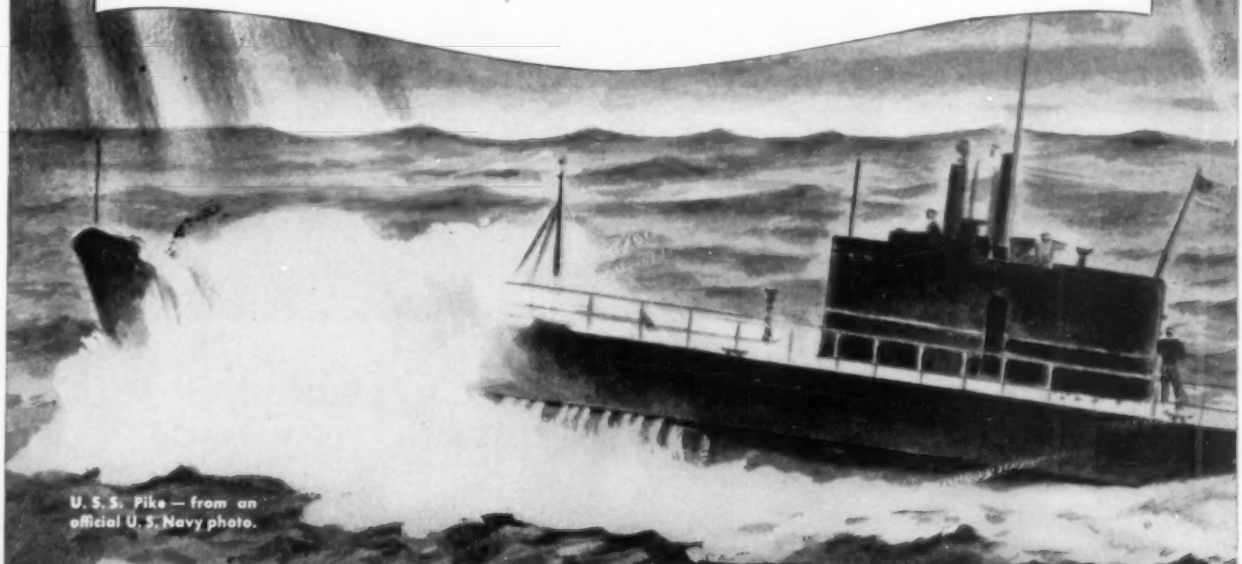
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

HONOR ROLL

Among the U. S. submarines and their personnel which have been awarded decorations for service against the enemy are the following:

U.S.S. Porpoise	U.S.S. Haddock	*U.S.S. Tang	U.S.S. Bang
U.S.S. Pike	U.S.S. Halibut	U.S.S. Apogon	U.S.S. Pintado
U.S.S. Plunger	*U.S.S. Herring	U.S.S. Aspro	U.S.S. Plaice
U.S.S. Pollack	U.S.S. Kingfish	U.S.S. Batfish	U.S.S. Sterlet
U.S.S. Snapper	U.S.S. Shad	U.S.S. Archerfish	U.S.S. Queenfish
U.S.S. Stingray	*U.S.S. Grayling	U.S.S. Sandlance	U.S.S. Redfish
U.S.S. Drum	*U.S.S. Grenadier	U.S.S. Picuda	U.S.S. Burfish
U.S.S. Flying Fish	*U.S.S. Gudgeon	U.S.S. Pampanito	U.S.S. Pipefish
U.S.S. Finback	U.S.S. Seahorse	U.S.S. Parche	U.S.S. Piranha
			U.S.S. Ronquil

*Reported missing and presumed lost.



U. S. S. Pike — from an official U. S. Navy photo.

FOR GALLANTRY IN ACTION

The U. S. submarines listed have achieved distinction either through the bestowal of the Presidential Unit Citation, or the awarding of individual honors to their personnel while engaged in operations against the enemy.

Since the success of these operations attests not only the courage and high devotion to duty on the part of officers and crew, but also dependable performance of equipment, we are more than pleased to state that all of the submarines listed (as well as many others not represented), are served by

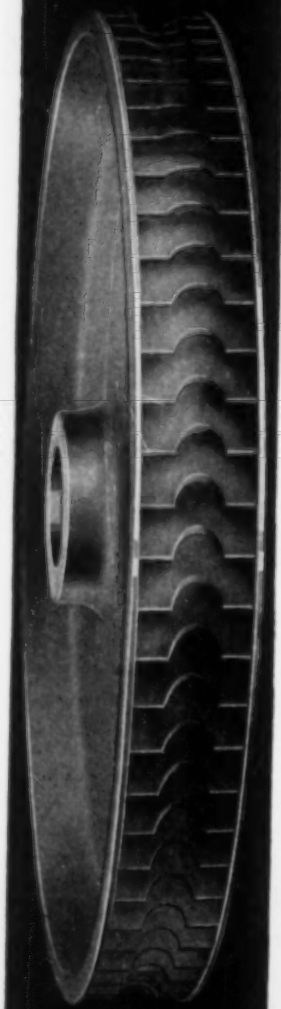
ELLIOTT ELECTRICAL PROPELLING MACHINERY—GENERATORS, MOTORS

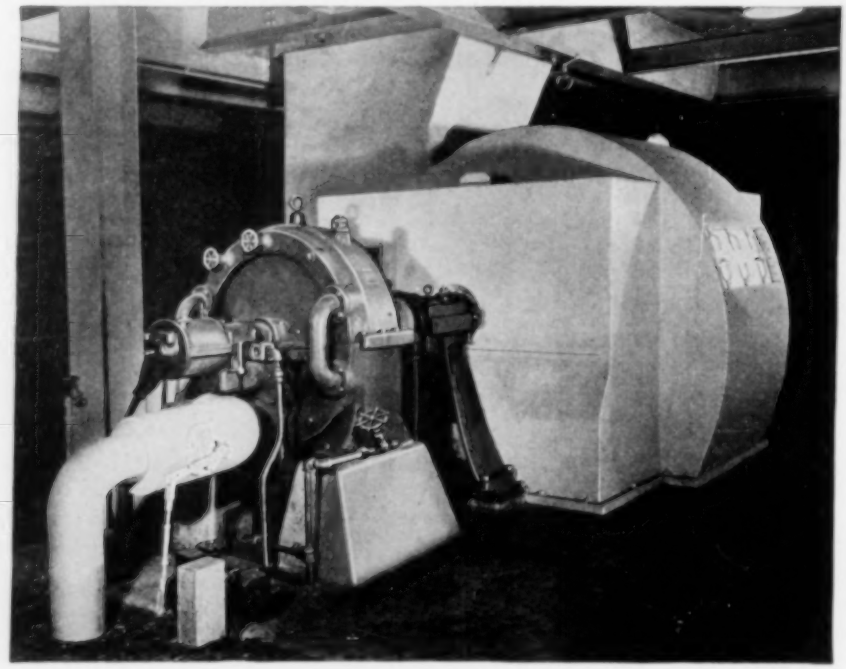
Q-1121A

ELLIOTT COMPANY

ELECTRIC POWER DEPARTMENT
RIDGWAY, PA.
DISTRICT OFFICES IN PRINCIPAL CITIES

TERRY





BUCKETS AND ROTOR IN THE TERRY WHEEL TURBINE
ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

ABOVE: 250 H. P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Lake Shore Mining Hoists

..engineered to fit your requirements

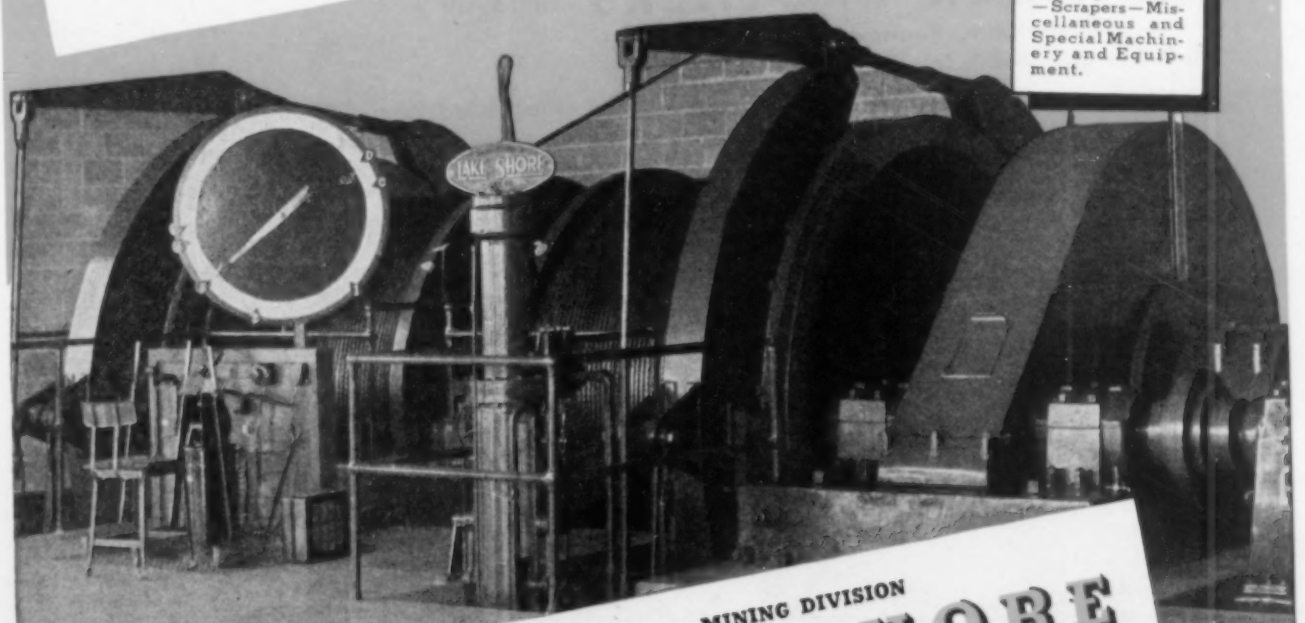
• More than fifty years design and manufacturing experience are built into every Lake Shore Hoist. Lake Shore Single and Double Drum Man and Material, Sinking, and Sub-Level Hoists are manufactured to meet an extra-ordinarily great variety of demands. They are available in drum diameter sizes of from two to ten feet. Write today.

World's Most Complete Line of Custom Engineered Mining Equipment

types of construction available:

- DRUMS—Plate Steel, Cast Steel, Nickel Iron, Cast Iron
- BRAKES—Welded, Cast Iron
- BRAKE DRUMS—Floating, Solid
- BRAKE BEAMS—Asbestos Lined, Basswood Lined
- COUPLINGS—Flexible, Solid
- DRIVE—Through Drum, Through Shaft
- SPIDERS—Cast Iron, Cast Steel
- CLUTCH—Friction, Geared
- DRUM SIZES—2′ to 10′ Diameter
- LUBRICATION—Sight Feed, Ring Oiling, Chain Oiling, Pump and Gravity, or Pressure Type

Skips—Cages—Hoists—Sheaves—Cars—Grizzlies—Crushers—Conveyors—Snatch Blocks—Accumulators—Log Washers—Ball Mills—Sinking Buckets—Scrapers—Miscellaneous and Special Machinery and Equipment.



• Write for new catalog No. 449 for complete information on Lake Shore Single and Double Drum Man and Material, Sinking, and Sub-Level Hoists.

MINING DIVISION

LAKE SHORE ENGINEERING COMPANY

Iron Mountain, Michigan

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Look to Lake Shore for Leadership

MONOBELT

Engineered to operate compressor drives efficiently, continuously.

Throughout industrial circles, "MONOBELT" (Patented) is known as the belt that saves money—because it costs less in the long run, due to its greater efficiency and longer life.

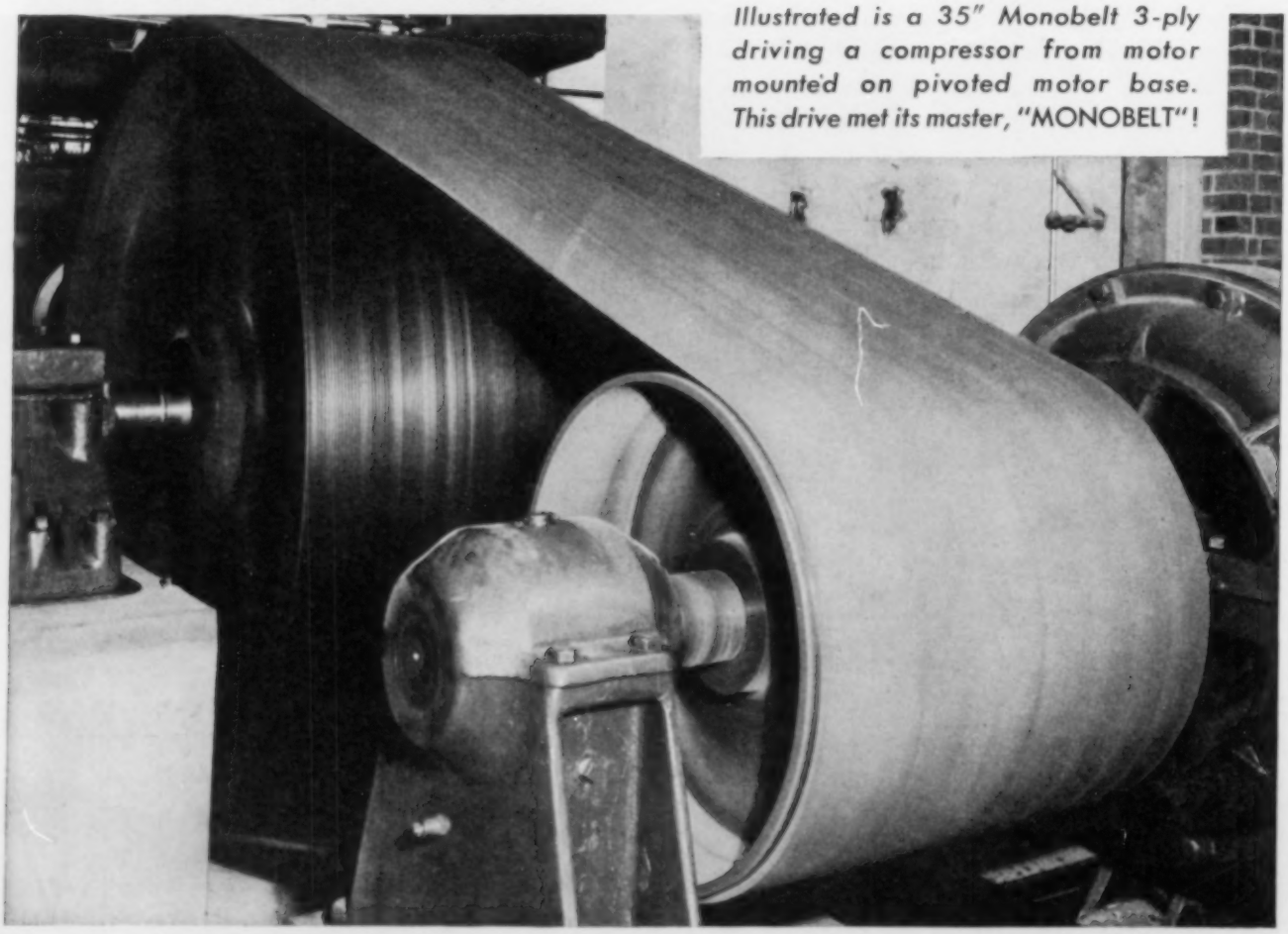
"MONOBELT" (Patented) is a leather belt that is pliable, waterproof, tough, durable and has high horsepower capacity. Given a factory run-in before it is shipped, "MONOBELT" requires no "Breaking-in": it reaches you ready to render money saving service in your plant from the first day in operation

"MONOBELT" is engineered to operate compressor drives efficiently . . . economically . . . continuously

★

ALEXANDER BROTHERS

Philadelphia, Pennsylvania
Branches and Distributors in Principal Cities



Illustrated is a 35" Monobelt 3-ply driving a compressor from motor mounted on pivoted motor base. This drive met its master, "MONOBELT"!

Excavating . . .

WET or DRY

Your excavating problems—whether they involve millions of yards of underwater excavation or peeling off miles of overburden — are never too big for profitable solution with Bucyrus-Erie machines. In dredging as in dry land excavating, you need designed-for-the-job Bucyrus-Eries to get the most in output — and profit. For profit-to-you is the natural result of Bucyrus-Erie's policy, continued for more than 60 years, of studying your needs and manufacturing machines that are **RIGHT** for your work.

That's why Bucyrus-Eries predominate on the toughest excavating jobs — wet or dry — all over the world . . . why **you'll** profit most by using Bucyrus-Erie excavators.

V-57

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

1,250,000
Pounds of Steam Per Hour
FOR PHILLIPS PETROLEUM CO.'S BORGER, TEXAS
BUTADIENE PLANT

Five Vogt Class VR Steam Generators

provide 1,250,000 pounds of steam each hour for the production of butadiene, so vital to America's synthetic rubber program. The steam is used directly in process and for prime mover power with exhausts for process purposes.

Photo courtesy Phillips Petroleum Co.

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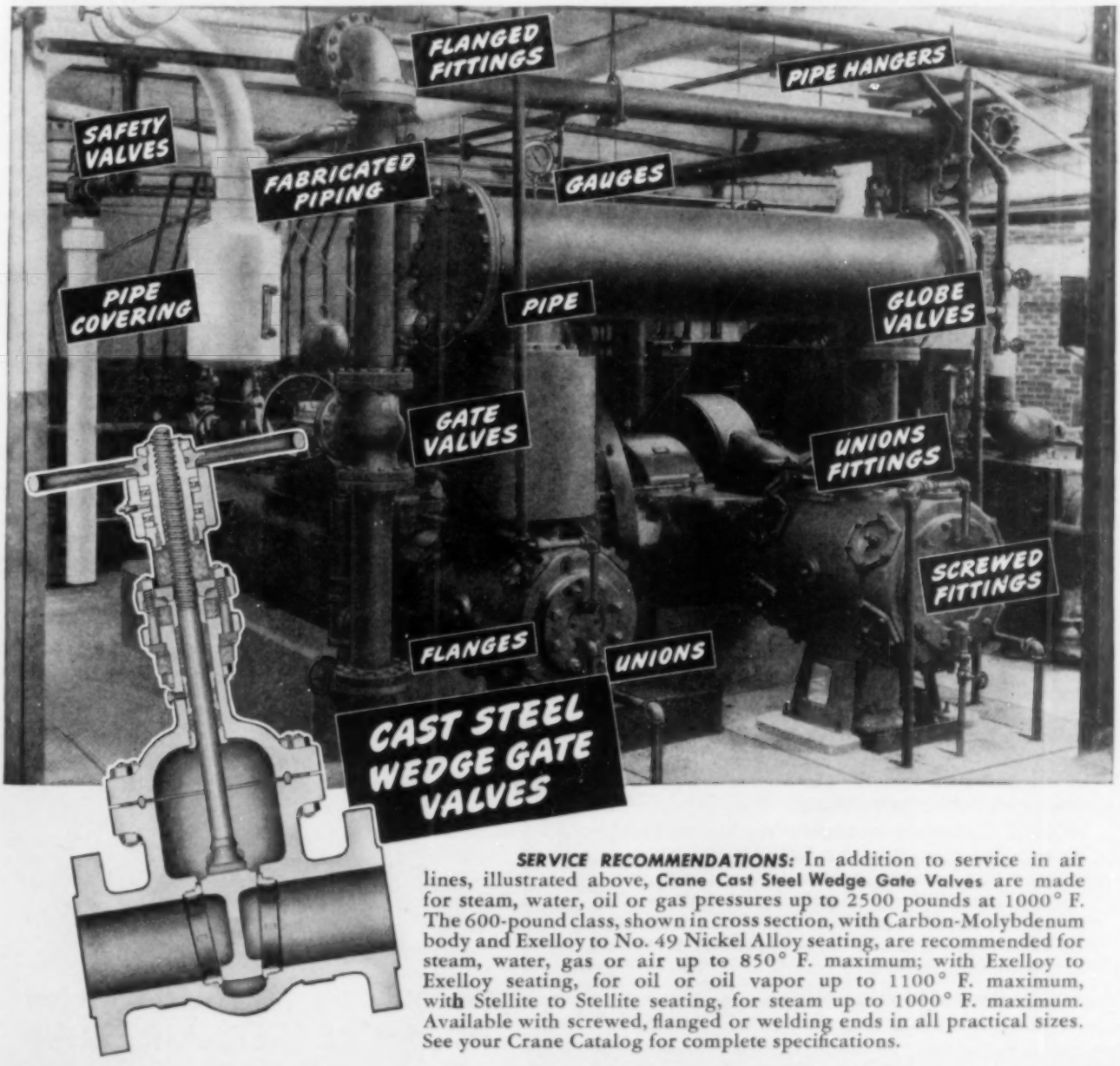
Wherever You Need Piping Materials
...RELY ON CRANE

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

Supplying everything necessary for any piping system is the job of your Crane Branch or Wholesaler. This single source offers the world's greatest selection of piping materials—in brass, iron and steel. Uniform quality in all materials—backed by single responsibility—helps assure the best installation. By using Crane *complete* piping materials service, you speed deferred replacements—keep piping performance at its best. Below is an example of the completeness of the Crane line—in Cast Steel Wedge Gate Valves.

Steam-Driven Air Compressor

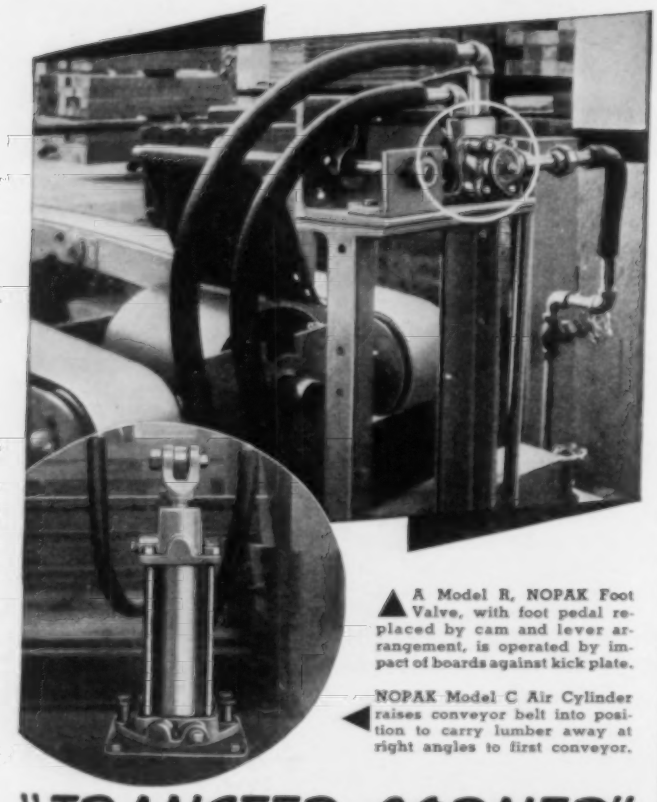


SERVICE RECOMMENDATIONS: In addition to service in air lines, illustrated above, **Crane Cast Steel Wedge Gate Valves** are made for steam, water, oil or gas pressures up to 2500 pounds at 1000° F. The 600-pound class, shown in cross section, with Carbon-Molybdenum body and Exelloy to No. 49 Nickel Alloy seating, are recommended for steam, water, gas or air up to 850° F. maximum; with Exelloy to Exelloy seating, for oil or oil vapor up to 1100° F. maximum, with Stellite to Stellite seating, for steam up to 1000° F. maximum. Available with screwed, flanged or welding ends in all practical sizes. See your Crane Catalog for complete specifications.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS



▲ A Model R, NOPAK Foot Valve, with foot pedal replaced by cam and lever arrangement, is operated by impact of boards against kick plate.

◀ NOPAK Model C Air Cylinder raises conveyor belt into position to carry lumber away at right angles to first conveyor.

"TRANSFER CORNER"

of Lumber-Mill Conveyor

is "NOPAK OPERATED"

The Pacific Lumber Co., Scotia, Cal. uses NOPAK Air Cylinders, controlled by NOPAK Valves, for manual and automatic actuation of many units of its extensive conveyor system.

The "transfer corner" pictured is a typical example. As the boards come down the first conveyor belt, they run into a "kick plate" connected to the valve lever by cams and rods. The impact of the boards against the plate operates the valve, actuating the cylinder, which raises the twin conveyor belts above the level of the first belt, to carry the boards off at right angles for further processing.

NOPAK Cylinders operated by Air or Fluid Power, and controlled by NOPAK Valves, are serving in hundreds of material-handling, pulling, pushing, lifting and holding operations . . . in all types of industry. Ask your nearest NOPAK representative for suggestions or write for Illustrated Bulletins.

GALLAND-HENNING MFG. CO., 2759 S. 31st St., Milwaukee 7, Wis.

NOPAK

VALVES AND CYLINDERS

DESIGNED for AIR AND HYDRAULIC SERVICE

A 4808-½R2

PRESSURE, FLOAT & VACUUM SWITCHES

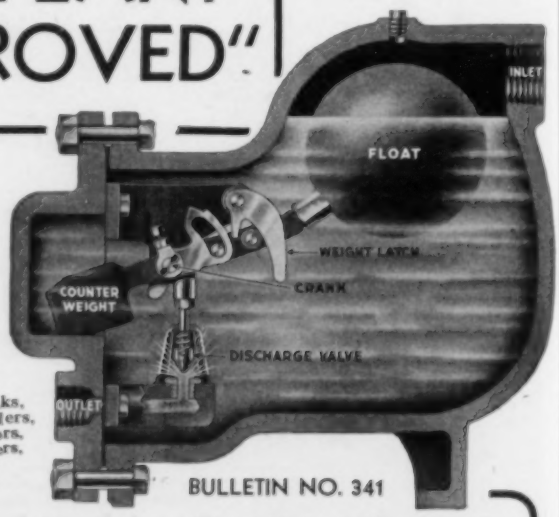
• **SQUARE D** offers a wide range of switches, designed and built for practically all sizes of water pumps, condensate pumps, vacuum pumps, and air compressors. You'll find this catalog a valuable source of reference. Send for your free copy today. Address Regulator Division, Square D Company, 6060 Rivard St., Detroit 11, Mich.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

"PLANT PROVED"

Nicholson Model "JR" Compressed Air Trap



For Air Tanks, Aftercoolers, Separators, Receivers, Etc.

BULLETIN NO. 341

America's Fastest Acting

COMPRESSED AIR TRAP

Due to their exclusive weight-operated design, Nicholson Model "JR" Compressed Air Traps open and close instantaneously, giving full faster drainage of water and oil. Plant-proved for most air applications.

W. H. NICHOLSON & CO.

180 OREGON ST., WILKES-BARRE, PA.

Valves • Traps • Steam Specialties

THE Chips TELL THE STORY

The evaluation of work actually done by a chipping hammer.

If someone told you that your chipping hammers were operating at only 60% cutting efficiency, you wouldn't believe them. Yet it has been found that even good operators cannot be relied upon to find 20% or less difference in the cutting ability of a group of hammers. That difference must be found by measuring the actual metal removed.

Recently a large plant asked our "cutting efficiency service" engineers to check their hammers. Tests soon showed that most of them were in very poor operating condition, so all types were shipped to our factory for a standard comparison cutting test against master hammers. Reports showed that they varied from 40% to 70% low in C. E. and were 6% high in air consumption.

From the tests it was obvious that the continued use of these hammers would cost thousands of dollars. Those beyond economical repair were replaced with I-R Flapper-Valve hammers and the balance were repaired as outlined by our service engineers. Production costs were reduced and more chipping per operator resulted.

An I-R service engineer will be glad to show you how to maintain the highest cutting efficiency for your hammers. A copy of our handy two-color Chipper Repair Wall Chart is yours for the asking.

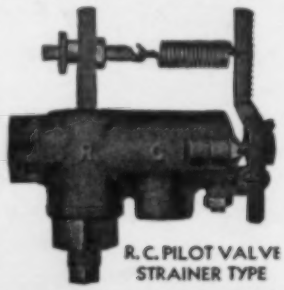
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

8-564

R. C. PILOT VALVES FOR POSITIVE CONTROL

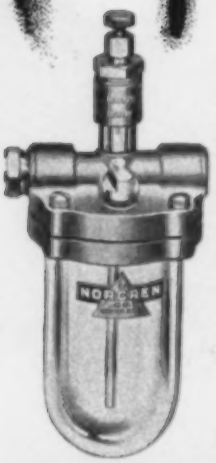
R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R.C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET · ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

PROTECTED by... FOG



Norgren Lubricators in the air lines protect your air driven tools and cylinders from costly repairs, with "air-borne" lubrication. Automatically inject exactly the right amount of oil into the air stream, creating an "oil fog" that travels with the air. This lubricates ALL moving parts when the tool is working. Prevents rust and corrosion when the tool is idle. Pays for itself *in a hurry!*

Write C. A. Norgren Co., 220 Santa Fe Drive, Denver 9, Colorado.

Norgren

The LIFE-BLOOD of a PENCIL is the LEAD!

Watch the *Navigator* Pencil go to work! Notice the unusual strength of the lead – its smooth uninterrupted flow of continuous performance-right down to the last dot!

Surround that fine quality lead with a "backbone" of straight grained cedar–smoothly finished. Add both together and you have a pencil that unquestionably is a leader in its particular class.

Send For Leaflet No. 19

KOH-I-NOOR PENCIL CO., Inc.
Bloomsbury, New Jersey

It Pays

to Put Your Compressed Air Through an Aridifier!

The constantly clean, dry compressed air provided by the Aridifier doesn't cost—it pays.

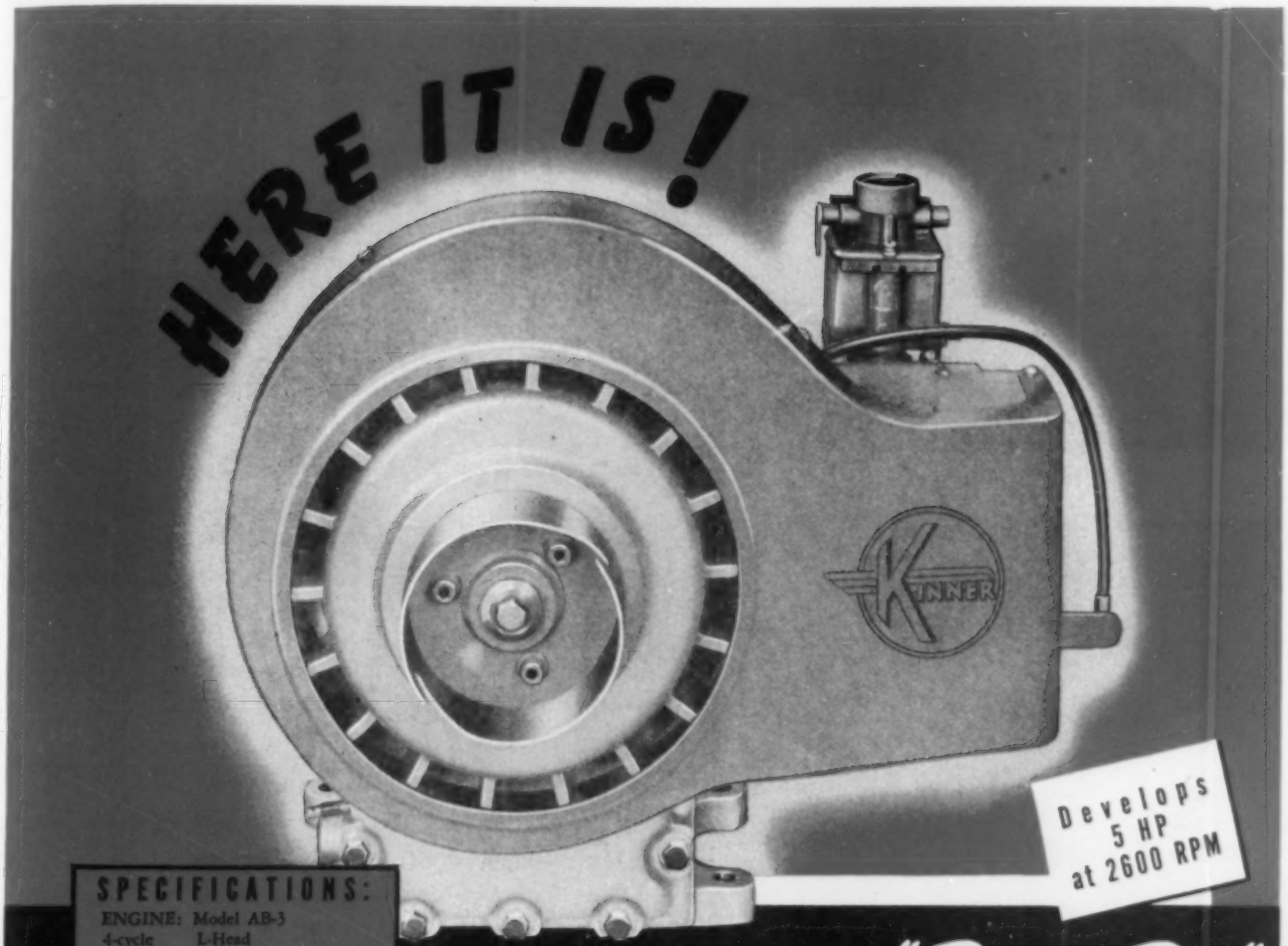
What it saves by lowering maintenance costs on air tools, hoists and controls quickly pays for the Aridifier. This effective air cleaner also saves by removing contamination from air lines serving spray booths, eliminating spoiled finishes.

The Aridifier thoroughly removes moisture, dirt and oil from compressed air by centrifugal force. Contains no filters, nothing to clean, replace or regulate. Its action is continuous and automatic. Thousands are in use—476 in one aircraft plant. Sizes for ⅜" to 10" pipe.

Let us send you Bulletin 543.

Logan Engineering Co.
4911 Lawrence Ave., Chicago 30, Ill.

Logan ARIDIFIER
Dries and Cleans Compressed Air



THE REVOLUTIONARY "Busy Bee"

SPECIFICATIONS:

ENGINE: Model AB-3
4-cycle L-Head
HORSEPOWER: 5 BHP, at 2600 rpm.
CYLINDERS: one, horizontal, detachable
BORE: 2¾ Inches
STROKE: 3 Inches
PISTON DISPLACEMENT: 17.8 Cu. Inches
COMPRESSION RATIO: 5.4 to 1
FUEL: 70 Octane fuel or better
COOLING: Air from Flywheel Fan
LUBRICATION: Full pressure from oil pump to all bearings. Wet sump of 2½ pints capacity.
IGNITION: High Tension Flywheel Magneto
STARTING: Rope
GOVERNOR: Air Type
CARBURETOR: Down draft with Maze type air cleaner
WEIGHT: 75 lbs.
SPACE OCCUPIED: 2.4 Cu. Feet. Height 15 Inches, width 18 inches, length 15-7/16 Inches
CRANKSHAFT: Steel with hardened and ground journals. Dynamically balanced.
CONNECTING ROD: Dural forging, heat treated.
PISTON: Aluminum alloy, heat treated
PISTON PIN: Steel, hardened and ground—¾ Inches diameter
CAM SHAFT: Cams hardened and ground
VALVE SEAT INSERTS: Two, of hardened steel.
HEAD: Aluminum alloy, heat treated.
CRANKCASE AND REAR COVER: Aluminum alloy, heat treated.
VALVES: Two, 1-15/32 Inches dia.
COMPRESSION RINGS: Two of 1/16 Inches width
OIL CONTROL RING: One of 3/32 Inches width
CONNECTING ROD, LENGTH: 6 Inches
POWER TAKE-OFF SHAFT: 1 Inch. Rotation is counter clockwise facing shaft.
SPARK PLUG: 14 MM

HIGH PERFORMANCE LOW COST
RUGGED LIGHT COMPACT

The revolutionary "Busy Bee" engine by Kinner embodies principles which are new as applied to small engine design and manufacturing. Daring in design and engineering, it has these unique features:

- Rated at 5 HP, it actually develops 6 at 3250 rpm.
- Aircooled, 4-cycle, L-Head.
- Horizontal cylinder, detachable—easily replaced.
- Simple, clean design makes maintenance easy.
- Light metal alloys make it lightest engine in its horsepower class—very advantageous for portable units.
- Aluminum head, piston and crankcase materially improve cooling characteristics.
- Full pressure lubrication to all bearings.
- Flat torque curve—the "Busy Bee" will "lug" under heavy loads.
- All bearing surfaces hardened—for longer life.
- Bearings large—bearing pressures low.

The Kinner "Busy Bee" is built for universal service under all conditions. Write on your letterhead for illustrated brochure, engineering data. KINNER MOTORS, INC., GLENDALE 4, CALIFORNIA.

Kinner

1919-1945 ENGINE BUILDERS FOR OVER A QUARTER CENTURY

A WINNING PAIR

for Quarrying, Metal Mining, Construction

● This pair of modern explosives—Hercomite* and Gelamite* — will bring you maximum breakage per dollar of cost . . . a 10% to 15% saving as compared to older type explosives.

Users of Hercomite and Gelamite report satisfactory results for both surface and underground work. That's why Hercomite and Gelamite are more widely used today than ever before.

There is a strength and grade that will give greater efficiency and economy for almost every type of blasting. Write us for further information.

HERCULES

EXPLOSIVES DEPARTMENT

HERCULES POWDER COMPANY

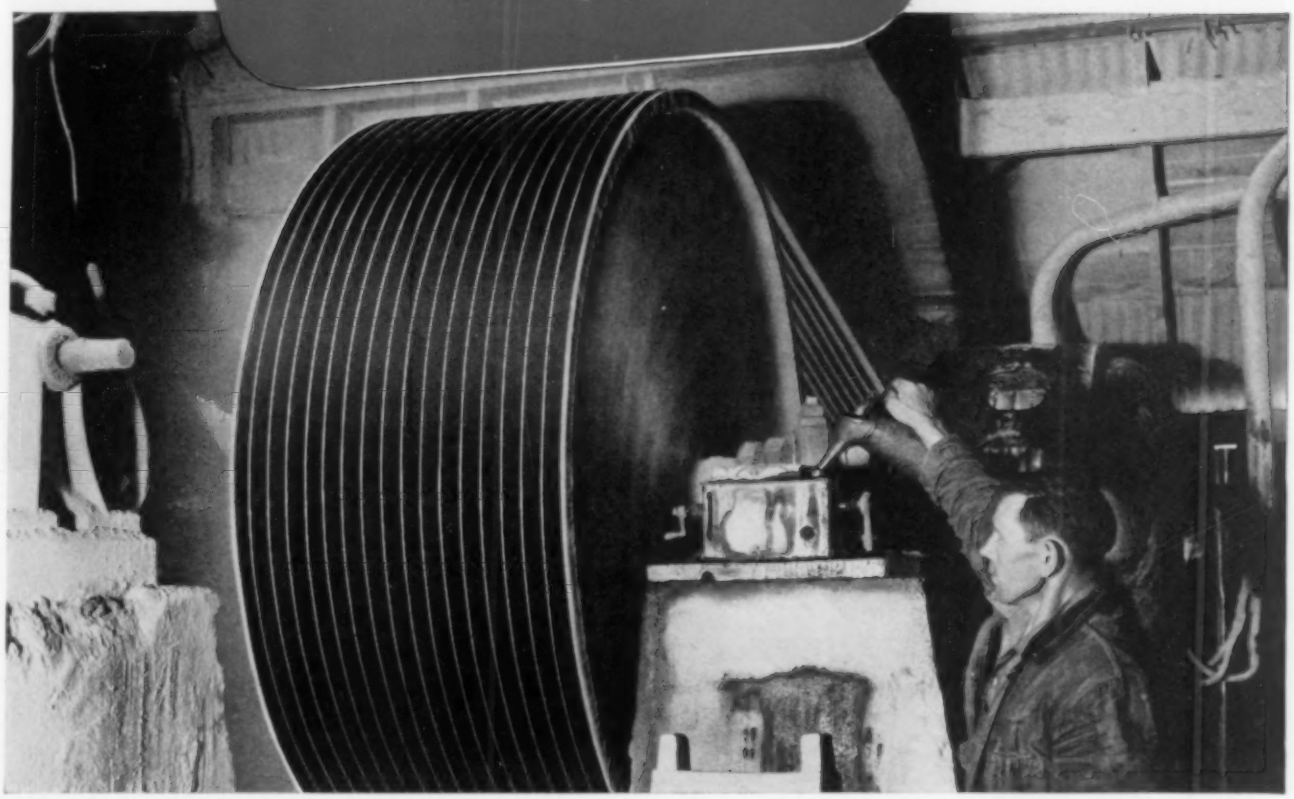
INCORPORATED

932 KING ST., WILMINGTON 99, DEL.

Reg. U. S. Pat. Off. by Hercules Powder Company

XR-55

Crushing Stone Slashing Costs!



- **Maintenance cost — reduced 50%**
- **Compact drive — saves four-fifths space**

In operation 24 hours a day under peak loads, this modern drive decreased maintenance cost 50% over the former type drive. The Lime and Stone Company found Dayton V-Belts required one-fifth as much space because of extreme short center-to-center distances possible without the use of idlers.

Other important advantages—since Dayton V-Belts deliver full power with less belt tension, they prevent excessive bearing wear . . . and by absorbing terrific shock loads, lengthen the life of your equipment.

Your Dayton V-Belt Distributor can bring advantages like these into your plant. It will pay to investigate Dayton's three exclusive advantages:

1. Dayton Rubber, as World's largest manufacturer of V-Belts, offers you vast experience in Power Transmission Engineering.

2. This experience is made available to you through trained specialists in your Dayton V-Belt Distributor's Organization.

3. The technical excellence of Dayton Rubber gives you V-Belts pronounced unsurpassed both in mechanically correct design and in quality of construction.

Call *your* Dayton V-Belt Distributor! Ask how Dayton Power Transmission Engineering can help you.

THE DAYTON RUBBER MANUFACTURING COMPANY
DAYTON 1, OHIO
THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

V-Belts by

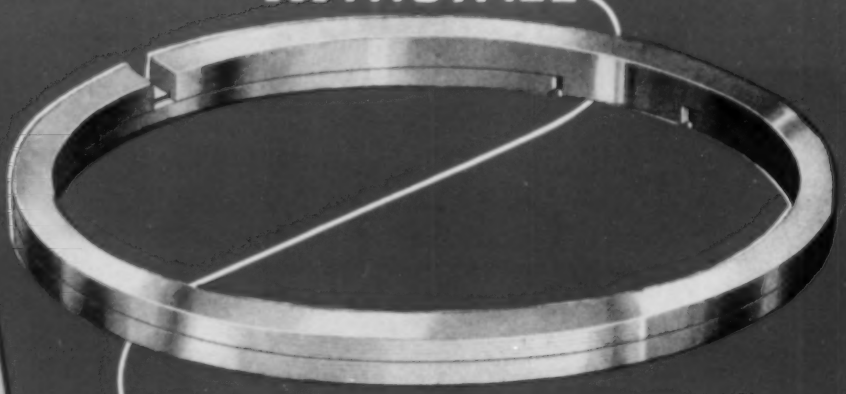
Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

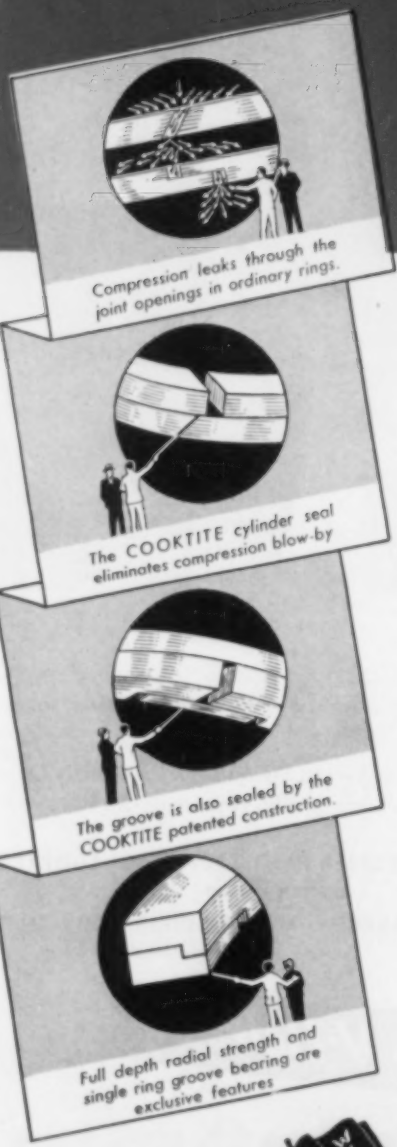
THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

Get MORE HORSEPOWER - Now!

... INSTALL



COOKTITES


Compression leaks through the joint openings in ordinary rings.
The COOKTITE cylinder seal eliminates compression blow-by
The groove is also sealed by the COOKTITE patented construction.
Full depth radial strength and single ring groove bearing are exclusive features

YES, by simply replacing two of the ordinary rings on each piston with COOKTITES you will immediately get more horsepower—up to 25% more, depending on your engine's present cylinder wear condition. Even if cylinders are badly worn, COOKTITES, properly applied, will restore "new engine" power. These are not just theories. They're facts, established by records of thousands of installations.

And why will COOKTITES assure increased horsepower? Because they will completely stop the leak of compression through the unsealed gap openings of the ordinary rings. True, this "blow-by" through the ordinary rings is small at first—but it accelerates fast as rings and cylinders wear, and it is a big factor in speeding up the wear.

Thus, with ordinary rings only, you continually get less and less power from the fuel burned—which, of course, means a progressively greater waste of fuel. Put a couple of COOKTITES on each piston and you end all this, because there are no gap openings in COOKTITE construction through which pressure can escape. From the start, COOKTITES provide a 100% positive cylinder seal—and they maintain it as long as they last. Many other advantages also result when you install COOKTITES.

Of course, you want the full story. It's yours for the asking. Write for it—today.

Sealing Pressures Since 1888

C. LEE COOK MANUFACTURING CO.

INCORPORATED

LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

A dependable source of Air Power
TIMKEN BEARING EQUIPPED

The truck-mounted compressor shown in the photograph, like various other types of compressors manufactured by the Ingersoll-Rand Company, is equipped with Timken Tapered Roller Bearings on the crank shaft. Thus it gives the user anti-friction advantages in full, because Timken Bearings not only reduce friction to the verge of elimination; they safely carry radial loads, thrust loads and both together in any combination; and hold moving parts in constant alignment under all conditions of operation. Adding the efficiency and endurance of Timken Bearings to the soundness of Ingersoll-Rand design and construction, produces compressors that are able to stand up for longer periods under continuous capacity service with minimum attention for lubrication and maintenance. This is a time-conserving factor that every construction contractor can appreciate. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

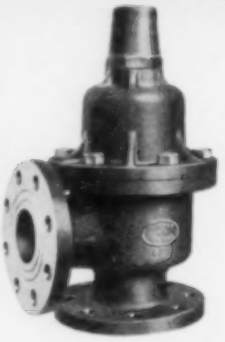
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Avoid over pressure dangers use FARRIS RELIEF VALVES

There's a dependable FARRIS Relief Valve for your every requirement. So why risk the dangers of over-pressure? Thousands of industrial and chemical plants, refineries, and power stations know the efficiency of FARRIS Relief and Safety Valves. And they're used on countless thousands of Merchant Marine and Naval vessels. Write today for Bulletin. *Be wise . . . specify FARRIS . . . and economize!*

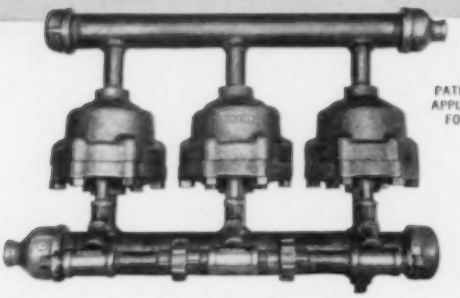
FARRIS ENGINEERING CO.
354 Commercial Ave., Palisades Park, N. J.



FARRIS ENCLOSED SPRING LIQUID RELIEF VALVE, Type 1450. In cast iron, cast steel, bronze. Long calibrated spring, pressure tight cap. Pressures to 600 lbs. Sizes 2" to 8". Available screwed outlet, test lever, pop construction, or handwheel for frequent changes of relief pressures.

Farris
SAFETY and RELIEF VALVES

Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



PATENT APPLIED FOR

Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

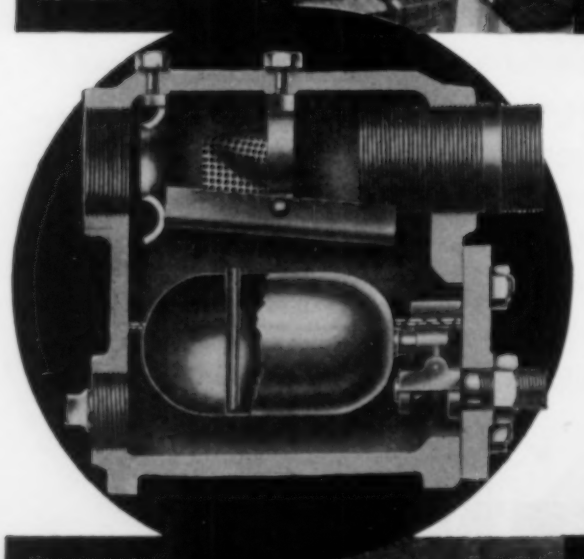
Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

The perfectly balanced Turbo-Rotor purifying action makes them sensitive to both regular and intermittent pressures. Write for Bulletin 10 giving complete details.

BIRD-WHITE COMPANY
Dept. CA, 3119 WEST LAKE STREET
CHICAGO 12, ILLINOIS

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

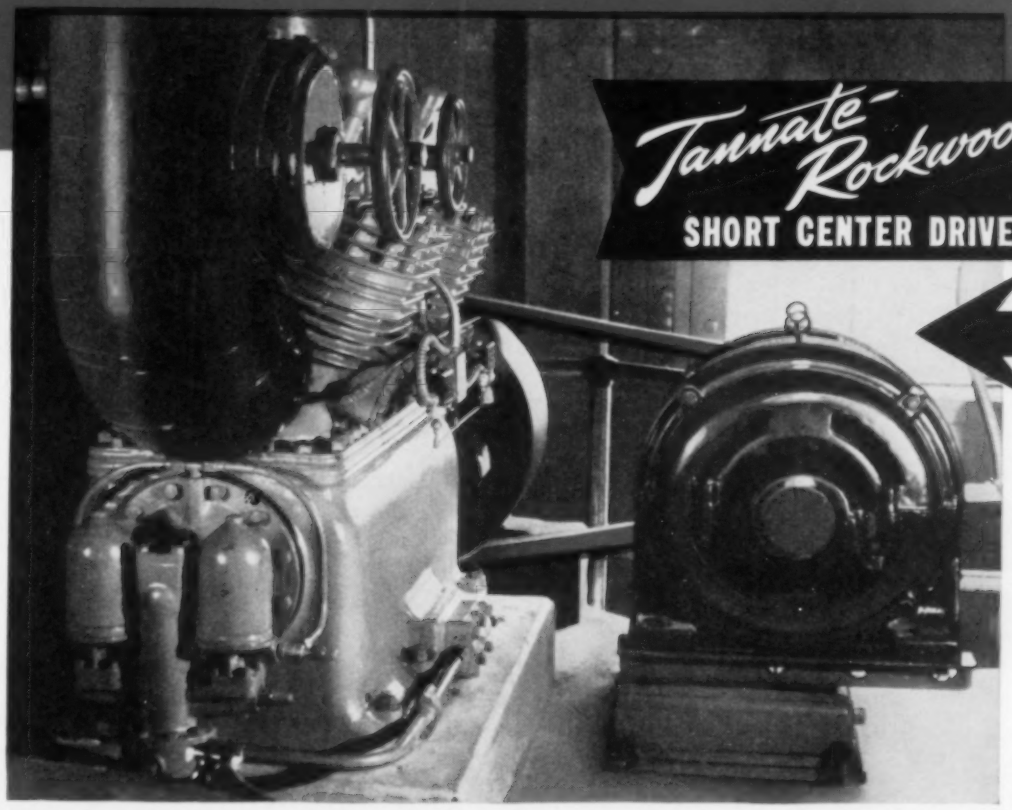
NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

THE COMPRESSOR DRIVE THAT GIVES ALL 3 ADVANTAGES

RELIABILITY · · · LONG LIFE CONTROLLED BELT TENSION



For a compressor drive that will give really dependable, trouble-free service over a long period of time it pays to select a Tannate-Rockwood Short Center Drive. This has been proven in numerous installations of which the one shown here is typical.

The Rockwood pivoted motor base provides a simple means of establishing correct belt tension when installed and for automatically maintaining it. This is the important factor in assuring maintenance of high efficiencies at peak loads for which the Tannate-Rockwood Drive is noted.

The great strength and flexibility and unusual endurance of the Tannate Leather Belt results in a long service life with almost no maintenance.

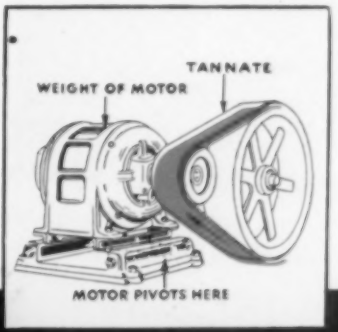
Rhoads Engineering Service is available to help you select the proper drives . . . send us your problems.

J. E. RHOADS & SONS • 35 N. Sixth St., Philadelphia 6, Pa.

Established 1702 • *NEW YORK* • *CHICAGO* • *ATLANTA*

INSTALLED IN 1939

on 100 HP motor operating compressors for air conditions system . . . still running with perfect satisfaction.



RHOADS

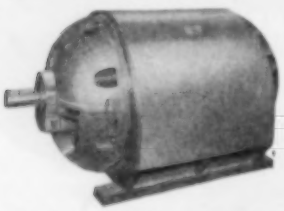
Tannate-Rockwood

SHORT CENTER DRIVE

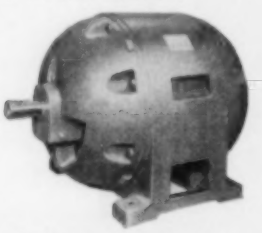
NOW your *big drives* can have it* too!

*The EXTRA protection of TRI/CLAD construction

Typical, large-size, sleeve-bearing Tri-Clad polyphase motor, now standard up to 2000 horsepower



Modified cast-iron frame construction used for certain large sizes of the extended Tri-Clad motor line



Separable housing construction used for large-size ball- or roller-bearing Tri-Clad motors. Roller bearings are standard at coupling end

G-E STANDARD Tri-Clad Induction Motors Now Available to 2000 Hp.

For that important *big* drive (up to 2000 hp, 3600 rpm) you can now get a G-E standard Tri-Clad induction motor with all the protective features that have proved so valuable in the more widely used sizes.

● 1. EXTRA PROTECTION FROM PHYSICAL DAMAGE

Cast-iron construction with upper portion completely enclosed to keep out falling objects, dripping liquids. Streamline, cast-iron end shields. Corrosion-resisting finish.

● 2. EXTRA PROTECTION FROM ELECTRICAL BREAKDOWN

Windings of Formex wire are solidly bonded with synthetic resins that are strongly resistant to oil and moisture. Formex wire insulation stands up remarkably under abrasion or "heat-shock."

● 3. EXTRA PROTECTION FROM OPERATING WEAR AND TEAR

Available with either sleeve or ball bearings—in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad motor bearing proportions, efficiently lubricated, with "air seal" to insure oil-tightness of the housing.

The Tri-Clad, in its wide range of types and sizes, is G.E.'s most widely used (integral-hp) motor. Chances are there's a Tri-Clad to meet your drive requirements "on the nose." Ask for Bulletin GEA-3580. ***General Electric Company, Schenectady 5, N. Y.***

NEW 2000-hp INDUCTION MOTOR LARGEST MEMBER OF TRI-CLAD FAMILY

Dwarfing the original Tri-Clad motor (resting on the conduit box) in size, this new 2000-hp "big brother" embodies all of the same protective construction features.

It operates at 1800 rpm, on 2300 volts, 60 cycles. This new 3-phase motor is in the 6360-frame series, which is five steps larger than the largest standard industry frame size (namely 505).

Here's Today's Wider Range of Standard Sizes	
TYPE K	1 hp to 2000 hp at 1800 rpm
TYPE KG (High starting torque, low starting current)	5 hp to 200 hp at 1800 rpm
TYPE KR (High starting torque, high slip)	Available to 100 hp in speeds required for high-slip, flywheel drive (punch presses, etc.)

Special motors can be custom-built in Tri-Clad design for YOUR problem. Induction motors specially designed to the job can generally be built with many of the Tri-Clad motor's strong points, such as enclosed upper portion, smooth cast-iron end shields, windings of Formex wire, and double-end ventilation.

GENERAL ELECTRIC

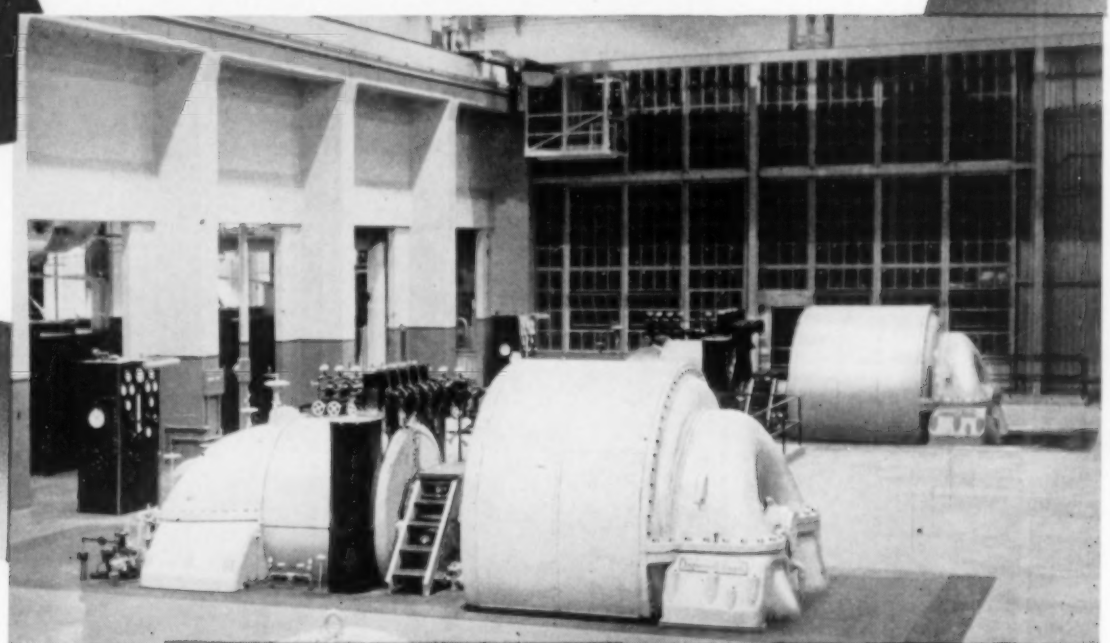
250-264C-1890

Buy all the BONDS you can
—and keep all you buy

COMPLETE BLAST FURNACE BLOWER UNITS

by Ingersoll-Rand

TURBO BLOWERS
SURFACE CONDENSERS
AIR EJECTORS
CONDENSATE PUMPS



All of the blast furnace blowing equipment for the new Fontana, California, steel plant of The Kaiser Company has been supplied by Ingersoll-Rand. This dual installation includes 100,000-cfm steam turbine driven turbo blowers; two-pass surface condensers, vertically divided for cleaning; twin-element two-stage steam-jet air-ejectors; a pair of condensate pumps serving each condenser.

These units embody every refinement of design and a number of operating and control features which contribute to economical and efficient blast air supply.

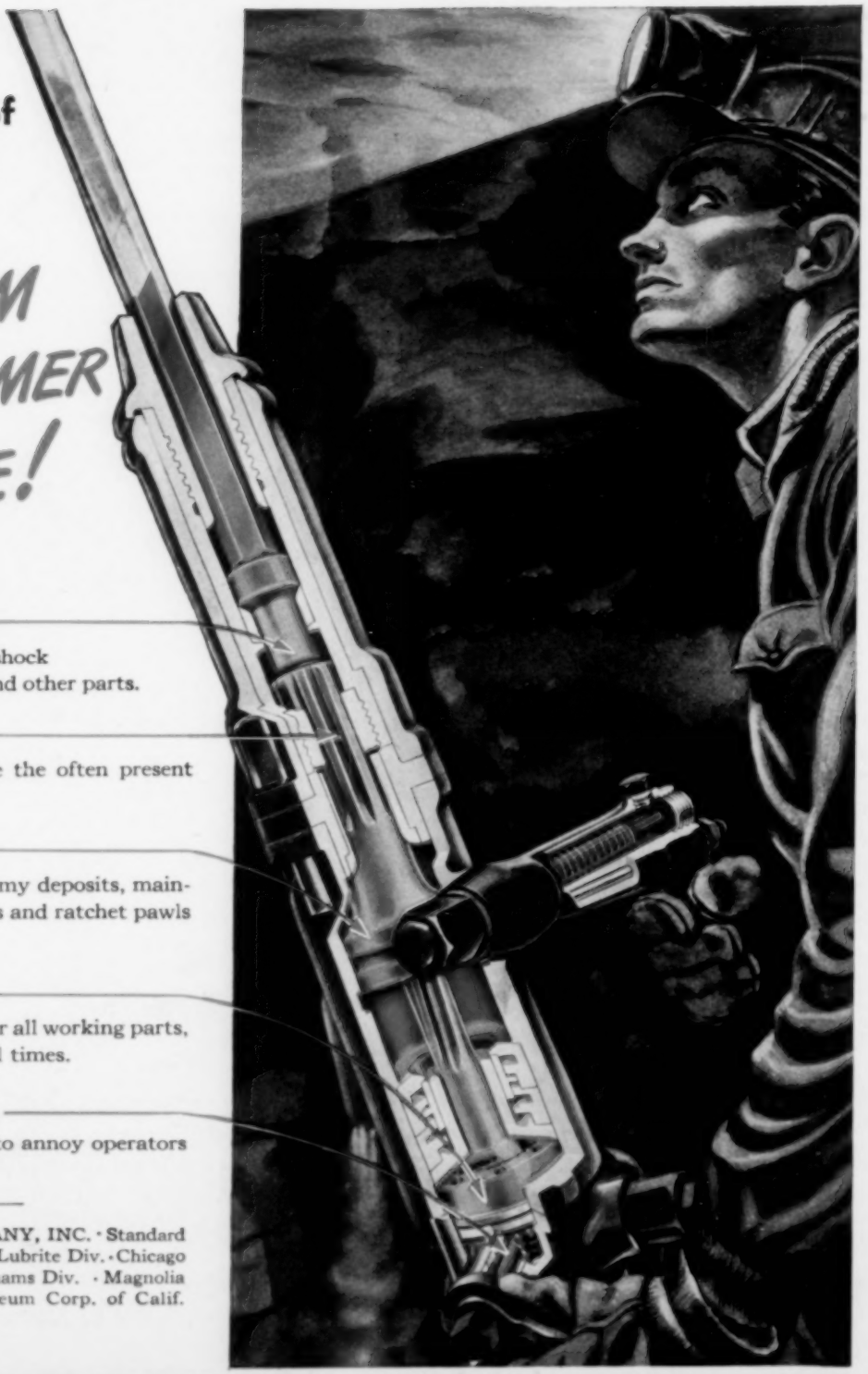
The purchaser of a *complete Ingersoll-Rand blast furnace blower unit* enjoys the advantage of unified engineering and undivided responsibility... and avails himself of the wide experience gained during more than three decades of building turbo blower equipment. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

12-655

COMPRESSORS • AIR TOOLS — ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Add up all these benefits of Gargoyle Almo Oil No. 3 for

MAXIMUM STOPEHAMMER FOOTAGE!



STRONG OIL FILMS
That stand up under severe shock loads imposed on rifle bars and other parts.

RESISTANCE TO WATER
Sticks on vital parts despite the often present washing action of water.

GREAT OIL STABILITY
Resists the formation of gummy deposits, maintains piston seal, keeps valves and ratchet pawls free.

CORRECT OIL BODY
Assures rapid distribution over all working parts, maximum piston speeds at all times.

NO OBJECTIONABLE ODOR
No fog or eye-burning effect to annoy operators and slow the work.

SOCONY-VACUUM OIL COMPANY, INC. · Standard Oil of N.Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div. · Magnolia Petroleum Co. · General Petroleum Corp. of Calif.

GARGOYLE

Lubricants

SOCONY-VACUUM'S 5 Steps to Lower Production Costs:

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured